KUNTHAVAI NAACCHIYAAR GOVERNMENT ARTS COLLEGE FOR WOMEN

An Autonomous College Affiliated to Bharathidasan UniversityRe-Accredited by NAAC with 'B' Grade

Thanjavur - 613 007, Tamil Nadu, India.

CBCS & OBE

Scheme of Instruction and Syllabus for

M.Sc., Mathematics

(Semester : I to IV)

Effective from 2023 - 2024 and onwards

PG & RESEARCH

DEPARTMENT OF MATHEMATICS

KUNTHAVAI NAACHIYAAR GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS)

PG DEPARTMENT OF MATHEMATICS

I. VISION

- To be a goal centers of excellent in mathematics for the growth of science.

II. MISSION

- To provide quality education and research in mathematics through updated curriculum and effective teaching learning process .
- To create stakeholders with both basic and applied mathematical knowledge.
- To create post graduate with strong skill and knowledge of mathematics.

III. PROGRAM OUTCOME (PO)

After completing the M.Sc Programme the students will be able to:

PO 1: Mastery of fundamental concepts of Algebra, Analysis , Geometry, measure, graph and probability theory.

PO2: Introduction to various courses like Wavelets, Fluid Dynamics, Fuzzy Sets and Their Applications and Statistical Data Analysis Using R-Programming

PO 3 : Communicate mathematical concepts effectively.

PO 4 : Analyze and model in real world problems based on mathematical principles.

PO 5 : Students will be able to strong in logical thinking and reasoning to solve any problems.

PO 6 : To use ICT mathematics teaching in mathematical modeling and probability theory.

PO 7 : Evaluate hypothesis, theories, methods and evidence within their proper contexts.

PO 8 : Assist students in preparing for competitive exam, NET, GATE, etc.,

PO 9 : Ability to carry out extended investigation of mathematical work as various projects independently.

PO 10 : Completion of this programme will also enable learners to join teaching profession.

V. PROGRAMME STRUCTURE

M.Sc Mathematics Course CBSC Structure with OBE for the candidates admitted 2023– 2024

Semester	Part	Course	Sub. Code	Title of the Course	Inst. Hrs	Credits	Exam Hrs	IA	EE	Total
I	A	CC1	23KP1M01	Algebraic Structures	7	5	3	25	75	100
		CC2	23KP1M02	Real Analysis I	7	5	3	25	75	100
		CC 3	23KP1M03	Ordinary Differential Equations	6	4	3	25	75	100
		EC1	23KP1MECM1:1	Graph Theory and Applications	5	3	3	25	75	100
			23KP1MECM1:2	Number Theory and Cryptography						
		EC2	23KP1MECM2:1	Fuzzy Sets and their Applications	5	3	3	25	75	100
			23KP1MECM2:2	Mathematical Programming						
				Total	**30**	**20**				**500**
II	A	CC4	23KP2M04	Advanced Algebra OG	6	5	3	25	75	100
		CC5	23KP2M05	Real Analysis II MA	6	5	3	25	75	100
		CC6	23KP2M06	Partial Differential Equations RP	6	4	3	25	75	100
		EC3	23KP2MECM3:1	Statistical Data Analysis Using R-Programming SK	4	3	3	25	75	100
			23KP2MECM3:2	Tensor Analysis and Relativity Theory						
		EC4	23KP2MECM4:1	Wavelets NV	4	3	3	25	75	100
			23KP2MECM4:2	Neural Networks						
	B	SEC1	23KP2MSEC1	Advanced LATEX SI-2 MG-2	4	2	3	25	75	100
	C	ECC1	23KP2MECC1:1	CSIR – NET Preparatory Course I		3*	3	-	100	100
			23KP2MECC1:2	MOOC (Value Added)						
		ECC2	23KP2MECC2	Introduction to MATLAB (Add on Course)	-	4*	-	-	-	-
				Total	**30**	**22**				**600**
III	A	CC7	23KP3M07	Complex Analysis	6	5	3	25	75	100
		CC8	23KP3M08	Probability Theory	6	5	3	25	75	100
		CC9	23KP3M09	Topology	6	5	3	25	75	100
		CC10	23KP3M10	Industry Modules	6	4	3	25	75	100

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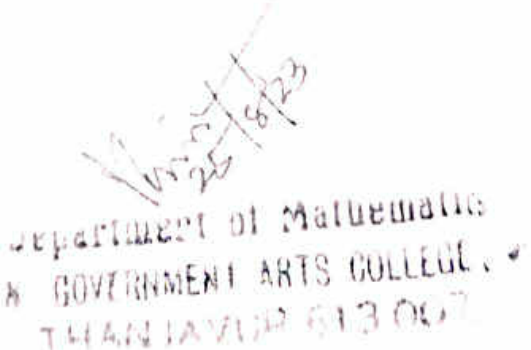
	EC5	23KP3MECM5:1	Stochastic Processes	3	3	3	25	75	100
		23KP3MECM5:2	Fluid Dynamics						
B	SEC2	23KP3MSEC2	Numerical Analysis using SCILAB	3	2	3	25	75	100
		23KP3I	Internship / Industrial Activity		2				
C	ECC3	23KP3MECC3:1	CSIR – NET Preparatory Course II		3*	3	-	100	100
		23KP3MECC3:2	MOOC (Value Added)						
			Total	**30**	**26**				**600**
A	CC11	23KP4M11	Functional Analysis	6	5	3	25	75	100
	CC12	23KP4M12	Differential Geometry	6	5	3	25	75	100
	CC	23KP4MPW	Project with viva voce	10	7	3	-	100	100
	EC6	23KP4MECM6:1	Resource Management Techniques	4	3	3	25	75	100
		23KP4MECM6:2	Financial Mathematics						
3	SEC3	23KP4MSEC3	Professional Competency Skill Enhancement Course Training for Competitive Examinations • Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours) • General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR Mathematics for Advanced Research Studies (4 hours)	4	2	3	25	75	100
	23KP4EA		Extension Activity		1				
			Total	**30**	**23**				**500**



V. ELECTIVES

M.Sc Mathematics – List of Elective Courses 2023– 2024

Semester I	Elective Courses	Subject Code
EC1	Graph Theory and Applications	23KP1MECM1:1
EC2	Fuzzy Sets and their Applications	23KP1MECM2:1
Semester II	**Elective Courses**	**Subject Code**
EC3	Statistical Data Analysis Using R-Programming	23KP2MECM3:1
EC4	Wavelets	23KP2MECM4:1
Semester III	**Elective Courses**	**Subject Code**
EC5	Stochastic Processes	23KP3MECM5:1
Semester IV	**Major Based Elective III**	**Subject Code**
EC6	Resource Management Techniques	23KP4MECM6:1

M.Sc Mathematics – Skilled Elective Courses 20223– 2024

Semester II	Skilled Elective Courses	Subject Code
SEC1	Advanced LATEX	23KP2MSEC1
Semester III	**Skilled Elective Courses**	**Subject Code**
SEC2	Numerical Analysis using SCILAB	23KP3MSEC2
	Internship / Industrial Activity	23KP3I
Semester IV	**Skilled Elective Courses**	**Subject Code**
SEC3	Professional Competency Skill Enhancement Course Training for Competitive Examinations • Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours) • General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR Mathematics for Advanced Research Studies (4 hours)	23KP4MSEC3

M.Sc Mathematics – Extra credit Course 2023– 2024

Semester II	Extra credit Courses	Subject Code
ECC1	CSIR – NET Preparatory Course I	23KP2MECC1:1
	MOOC (Value Added)	23KP2MECC1:2
ECC2	Introduction to MATLAB (Add on Course)	23KP2MECC2
Semester III	**Extra credit Course**	**Subject Code**
ECC3	CSIR – NET Preparatory Course II	23KP3MECC3:1
	MOOC (Value Added)	23KP3MECC3:2

VI. Details on the number of courses, Instruction Hours and Credits

Course	Course Title	No.of courses	Inst. Hours	Credits
Part A	Core Course 12(Theory) & 1(Project)	13	84	64
Part A	Elective Courses	06	25	18
Part B	Skilled Elective Courses	03	11	08
	Internship			
Part C	Extra credit Course	03	-	01
	Extension Activity			
	Total	**25**	**120**	**91**

VII. SEMESTER – WISE COURSE STRUCTURE

Semester	Course	Total Courses	Inst.Hours/week	Credits
I	CC, EC	5	30	20
II	CC, EC, SEC, ECC	8	30	22
III	CC, EC, SEC, ECC	8	30	26
IV	CC, EC,SEC,EA	6	30	23

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SYLLABUS FOR DIFFERENT COURSES OF

M.Sc MATHEMATICS

Title of the Course	**ALGEBRAIC STRUCTURES**						
Paper Number	**CORE I**						
Category Core	**Year**	I	**Credits**	5	**Course Code**	23KP1MO1	
	Semester	I					
Instructional Hours Per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	6	1	--	7			
Pre-requisite	UG level Modern Algebra						
Objectives of the Course	To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms						
Course Outline	**UNIT-I:** Counting Principle -Class equation for finite group's and its applications - Sylow's theorems (For theorem 2.12.1, First proofonly). **Chapter2:Sections2.11 and2.12(Omit Lemma2.12.5)**						
	UNIT-II: Solvable groups – Direct products –Finite abelian groups-Modules **Chapter5: Section5.7(Lemma 5.7.1,Lemma5.7.2,Theorem 5.7.1)** **Chapter2: Section2.13 and 2.14(Theorem2.14.1 only)** **Chapter4: Section 4.5**						
	UNIT-III: Linear Transformations: Canonical forms –Triangular form-Nilpotent transformations. **Chapter6: Sections 6.4, 6.5**						
	UNIT-IV: Jordan form- rational canonical form. **Chapter6 : Sections 6.6 and6.7**						
	UNIT-V: Traceandtranspose- Hermitian, unitary, normal transformations, real quadratic form. **Chapter6 :Sections6.8, 6.10 and6.11 (Omit 6.9)**						
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC /others to be solved (To be discussed during the Tutorial hour)						
Skills acquired from this course	Knowledge, Problem Solving, Analyticalability, Professional Competency, Professional Communication and Transferrable Skill						
Recommended Text	I .N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975.						

Reference Books	1. M.Artin,*Algebra*,PrenticeHallofIndia,1991. 2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (IIEdition)Cambridge UniversityPress,1997.(IndianEdition) 3. I.S.Luther and I.B.S.Passi, *Algebra*, Vol. I –Groups(1996); Vol.IIRings, Narosa Publishing House, NewDelhi. 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGrawHill (International Edition), NewYork.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

CLO1: Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups.

CLO2: Define Solvable groups, define direct products, examine the properties of finite abelian groups, and define modules.

CLO 3: Define similar Transformations, define invariant subspace, and 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, and 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 thetriangularform,definesymmetricmatrix,skewsymmetricmatrix,adjoint,todefineHermitian, 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

Strong:1 Medium:2 Low:3

Title of the Course		**REAL ANALYSIS I**					
Paper Number		**COREII**					
Category	Core	**Year**	I	**Credits**	5	**Course Code**	23KP1M02
		Semester	I				

Instructional Hours Per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	6	1	--	7

Pre-requisite	UG level real analysis concepts
Objectives of the Course	To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite productanduniformconvergenceanditsinterplaybetweenvariouslimiting Operations.
Course Outline	**UNIT-I: Functions of bounded variation-** Introduction -Properties of monotonic functions - Functions of bounded variation -Total variation - Additive property of total variation - Total variation on [a, x] as a function of x –Functions of bounded variation expressed as the difference of two increasing functions – Continuous functions of bounded variation. **Chapter– 6 : Sections6.1 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. Chapter8 : Sections8.8, 8.15, 8.17, 8.18
	UNIT-II: The Riemann-Stieltjes Integral-Introduction- Notation - The definition of the Riemann – Stieltjes integral- Linear Properties - Integration by parts- Change of variable in a Riemann – Stieltjes integral-Reduction to a Riemann Integral– Euler's summation formula-Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals -Riemann's condition-Comparison theorems. Chapter-7 : Sections7.1 to 7.14
	UNIT-III : The Riemann - Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems- integrals as a function of the interval–Second fundamental theorem of integral calculus-Change of variable –Second Mean Value Theorem for Riemann integral -Riemann-Stieltjes integrals depending on a parameter – Differentiation under integral sign-Lebesgue criteria on for existence of Riemann integrals. Chapter- 7 :7.15 to 7.26

	UNIT-IV: Infinite Series and infinite Products – Double sequences -Double series – Rearrangement theorem for double series-A sufficient condition for equality of iterated series - Multiplication of series Cesaro sum ability-Infinite products. **Chapter-8 Sec, 8.20, 8.21 to8.26** **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem **Chapter9 : 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 Sec9.1to 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) CONTROLLER OF EXAMINATIONS 08 AUG 2023
Skills acquired from This course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.
Recommended Text	Tom M. A postol: *Mathematical Analysis*,2nd Edition, Addison-Wesley Publishing Company Inc. NewYork,1974.
Reference Books	1. Bartle,R.G.*Real Analysis*, JohnWileyand SonsInc., 1976. 2. Rudin, W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976. 3. Malik ,S. C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Limited. New Delhi, 1991. 4. Sanjay Arora and BansiLal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991. 5. Gelbaum, B. R. and J. Olmsted, *Counter Examples in Analysis*, Holdenday, San Francisco, 1964. 6. A. L. Gupta and N. R. Gupta, *Principles of Real Analysis*, Pearson Education,(Indianprint)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

CLO 1: Analyze and evaluate functions of bounded variation and Rectifiable Curves.

CLO 2: Describe the concept of Riemann-Stieltjes integral and its properties.

CLO 3: Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.

CLO 4: Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.

CLO 5: Formulate the concept and properties of inner products, norms and measurable functions.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	1	3	2	3	3	3	2	1
CLO 2	2	1	3	1	3	3	3	2	1
CLO 3	3	2	3	1	3	3	3	2	1
CLO 4	1	2	3	2	3	3	3	2	1
CLO 5	3	1	2	3	3	3	3	2	1

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Department of Mathematics
N. GOVERNMENT ARTS COLLEGE
THANJAVUR-613 007

Title of the Course		**ORDINARY DIFFERENTIAL EQUATIONS**					
Paper Number		**CORE III**					
Category	Core	**Year**	1	**Credits**	4	**Course Code**	23KP1M03
		Semester	1				
Instructional Hours Per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**
		5		1		--	6
Pre-requisite		UG level Calculus and Differential Equations					
Objectives of the Course		To develop strong back ground 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.					
Course Outline		**UNIT-I:Linearequationswithconstantcoefficients** Second order homogeneous equations-Initial value problems-Lineardependenceandindependence-WronskianandaformulaforWronskian-Non-homogeneousequation of order two. **Chapter2: Sections 1 to6**					
		UNIT-II : Linear equations with constant coefficients Homogeneousandnon-homogeneousequationofordern–Initialvalue problems- Annihilator method to solve non-homogeneous equation-Algebra of constant coefficient operators. **Chapter2 : Sections 7 to 12.**					
		UNIT-III: Linear equation with variable coefficients Initialvalueproblems-Existenceanduniquenesstheorems–Solutionstosolveanon-homogeneousequation–Wronskianandlinear dependence–reduction of the order of a homogeneous equation Homogeneous equation with analytic coefficients-The Legendre equation. **Chapter:3Sections 1to8 (Omit section 9)**					
		UNIT-IV: Linear equation with regular singular points Euler equation – Second order equations with regular singular points–Exceptional cases – Bessel Function. **Chapter4:Sections1 to4 and6 to8(Omit sections 5and 9)**					
		UNIT-V:Existenceanduniquenessofsolutionstofirstorderequations:Equationwith variableseparated–Exactequation–methodofsuccessiveapproximations–theLipschitzcondition–convergenceofthesuccessiveapproximationsandtheexistencetheorem. **Chapter5 :Sections 1 to6 (Omit Sections7 to9)**					

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminatio ns 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. Coddingt on *A introduction to ordinary differentiable equations* (3rd Printing) Prentice-Hallof IndiaLtd.,New Delhi,1987.
Reference Books	Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wileyand sons, New York, 1967. George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965. W.T. Reid. *Ordinary Differential Equations*, John Wileyand Sons, NewYork, 1971 M.D. Raisinghania, *Advanced Differential Equations*, S. Chand & Company Ltd. New Delhi 2001 B.Rai,D.P. Choudary and H.I.Freedman, *A Course in Ordinary Differential Equations,* NarosaPublishingHouse,NewDelhi,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

CLO 1 : Establish the qualitative behavior of solutions of systems of differential equations

CLO 2 : Recognize the physical phenomena modeled by differential equations and dynamical systems.

CLO 3 : Analyze solutions using appropriate methods and give examples.

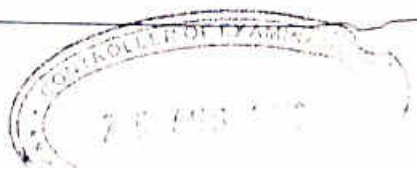
CLO 4 : Formulate Green's function for boundary value problems.

CLO 5 : Understand and usevarioustheoreticalideasandresultsthatunderliethemathematiesin this cou rse.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	1	3	2	3	3	3	2	1
CLO 2	2	1	3	1	3	3	3	2	1
CLO 3	3	2	3	1	3	3	3	2	1
CLO 4	1	2	3	2	3	3	3	2	1
CLO 5	3	1	2	3	3	3	3	2	1

A. GOVERNMENT ARTS COLLEGE (A
THANJAVUR-613 007.

Title of the Course		**GRAPH THEORY AND APPLICATIONS**					
Paper Number		**ELECTIVE– I**					
Category	Elective	**Year**	I	**Credits**	3	**Course Code**	23KP1MECM1:1
		Semester	I				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	1		--	5	
Pre-requisite		UG level Graph Theory					
Course Outline		**UNIT I: Basic Results:** Introduction – Basic Concepts-Sub graphs-Degrees of Vertices - Paths and Connectedness - Automorphism of a Simple Graph. (Chapter1:Sections1.1-1.6). Directed Graphs: Introduction-Basic Concepts-Tournaments. (Chapter2: Sections2.1-2.3).					
		UNIT II: Connectivity and Trees: Connectivity: Introduction-Vertex cut and Edge Cut-Connectivity and Edge Connectivity. (Chapter3: Sections 3.1- 3.3). Trees: Introduction - Definition, Characterization and Simple Properties – Centers and Centroids – Cutting the Number of Spanning Trees - Cayley's Formula. (Chapter4:Sections4.1-4.5).					
		UNIT III: Independent Sets, Matchings and Cycles: Independent Sets and Matchings: Introduction-Vertex-Independent Sets and Vertex Coverings-Edge-Independent sets- Matchings and Factors-Matchings in Bipartite Graphs. (Chapter 5: Sections 5.1- 5.5) . Cycles: Introduction-Eulerian Graphs Hamiltonian Graphs. (Chapter6:Sections6.1-6.3).					
		UNIT IV: Graph Colorings: Introduction-Vertex colorings-Critical Graphs-Edge colorings of Graphs - Kirkman's Schoolgirl- Problem-Chromatic Polynomials.(Chapter7:Sections 7.1 ,7.2,7.3 (7.2.1& 7.2.3only), 7.6,7.8, and 7.9).					
		UNIT V Planarity: Introduction- Planar and Non planar Graphs -Euler Formula and its Consequences K and K, 3 are Non planar Graphs–Dual of a Plane Graph- The Four-Color Theorem 5.3 and the Heawood Five-ColorTheorem-HamiltonianPlaneGraphs-TaitColoring.(Chapter8: Sections 8.1-8.6 ,8.8 and 8.9).					
Extended Professional Component		Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB / NET/ UGC–CSIR/ GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)					



Skills acquired from this course	Knowledge,ProblemSolving,Analyticalability,ProfessionalCompetency,Professional Communication and Transferrable Skill
Recommended Text	1.R.BalakrishnanandK.Ranganathan,TextBookofGraphTheory,(2ndEdition),Springer,NewYork,2012.
Reference Books	1. J. A. Bondy and U. S. R. Murty, Graph Theory with Applications. North Holl and, New York, 1982. 2. Narasing Deo, Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi. 2003. 3. F. Harary, Graph Theory, Addison-WeselyPub.Co.TheMass.1969. 4. L. R. Foulds, Graph Theory Application, Narosa Publ. House, Chennai,1933.
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 Understand and apply the fundamental concepts in graph theory.

CLO 2: To apply graph theory based tools in solving practical problems.

CLO 3: To Understand the Eulerian graphs and Hamiltinian graphs

CLO 4: To introduce the idea of coloring in graphs.

CLO 5: To develop the understanding of geometric duals in planar graphs.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	3	3	3	3	3	3	3	3
CLO 2	3	2	2	1	2	2	3	2	3
CLO 3	3	3	3	2	3	3	3	3	3
CLO 4	3	1	3	3	3	3	3	2	3
CLO 5	3	2	3	3	3	3	3	3	3

Department of Mathematics,
A. GOVERNMENT ARTS COLLEGE (A
THANJAVUR-613 007.

Title of the Course	NUMBER THEORY AND CRYPTOGRAPHY					
Paper Number	ELECTIVE - I					
Category: Elective	Year: I	Credits: 3	Course Code: 23KP1MECM1:2			
	Semester: I					
Instructional Hours Per week	Lecture	Tutorial	Lab Practice	Total		
	4	1	--	5		
Pre-requisite	UG level Number Theory					
Objectives of the Course	• To understand fundamental number-theoretic algorithms such as the Euclidean algorithm, the Chinese Remainder algorithm, binary powering, and algorithms for integer arithmetic. • To understand fundamental algorithms for symmetric key and public-key cryptography. • To understand the number-theoretic foundations of modern cryptography and the principles behind their security. • To implement and analyze cryptographic and number-theoretic algorithms.					
Course Outline	**UNIT I:** Elementary Number Theory: Time Estimates for doing arithmetic– divisibility and Euclidean algorithm – Congruencies' – Application to factoring. Chapter 1					
	UNIT II : Introduction to Classical Crypto systems – Some simple cryptosystems – Enciphering matrices DES Chapter 3					
	UNIT III : Finite Fields, Quadratic Residues and Reciprocity (Chapter2)					
	UNIT IV: Public Key Cryptography Chapter 4					
	UNIT V: Primality,Factoring,EllipticcurvesandEllipticcurvecryptosystems (Chapter5,sections1,2,3&5(omit section4),Chapter 6,sections1&2only)					
Extended Professional Component	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/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.NealKoblitz, A Course in Number Theory and Cryptography, Springer-Verlag,NewYork,1987
Reference Books	1. I.Niven and H.S. Zuckermann, An Introduction to Theory of Numbers (Edn.3), Wiley Eastern Ltd., NewDelhi,1976 2. David M. Burton, Elementary Number Theory, Brown Publishers,Iowa,1989 3. K. Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag, 1972 4. N.Koblitz,AlgebraicAspectsofCryptography,Springer1998.
Website and e-Learning Source	1. https://nptel.ac.in/courses/111101137 2. https://archive.nptel.ac.in/courses/106/103/106103015/ 3. https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

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

CLO 2: Distinguish the DES and the AES.

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

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

CLO 5: Explainhowellipticcurvesareusedincertain Crypto-graphicalgorithms.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	3	3	3	3	3	3	3	3
CLO 2	3	2	2	1	2	2	3	2	3
CLO 3	3	3	3	2	3	3	3	3	3
CLO 4	3	1	3	3	3	3	3	2	3
CLO 5	3	2	3	3	3	3	3	3	3

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Title of the Course		**FUZZY SETS AND THEIR APPLICATIONS**					
Paper Number		**ELECTIVE– II**					
Category	Elective	**Year**	I	**Credits**	3	**Course Code**	23KP1MECM2:1
		Semester	I				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	1		--	5	
Objectives of the Course		This course introduces advanced to set theory and number theory					
Course Outline		**Unit I: Fuzzy sets:** Fuzzy sets – Basic types – Basic concepts- Characteristics – Significance of the paradigm shift –Additional properties of α - Cuts (Chapter 1: Sections 1.3 to 1.5 and Chapter 2:Sections2.1)					
		Unit II: Fuzzy Sets Versus CRISP Sets: Representation of Fuzzy sets – Extension principle of Fuzzy sets – Operation on Fuzzy Sets – Types of Operation – Fuzzy complements. (Chapter 2: Sections 2.2 to 2.3 andChapter3: Sections 3.1 to 3.2)					
		Unit III: Operations on Fuzzy Sets: Fuzzy intersection – t-norms, Fuzzy unions – t co norms – Combinations of operations – Aggregation operations.(Chapter3: Sections 3.3 to 3.6)					
		Unit IV: Fuzzy Arithmetic: Fuzzy numbers – Linguistic variables – Arithmetic operation on intervals – Lattice of Fuzzy numbers (Chapter4: Sections 4.1 to 4.4)					
		Unit V: Constructing Fuzzy Sets: Methods of construction: An overview – Direct methods with one expert –Direct method with multiple experts – in direct method with multiple experts and one expert – Construction from sample data. (Chapter10: Sections 10.1 to 10.7)					
Extended Professional Component		Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC /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.J.Klir,andBoYuan,FuzzySetsandfuzzyLogic:TheoryandApplications,PrenticeHallofIndia Ltd., New Delhi, 2005.
Reference Books	1.H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996. 2. A. Kaufman, Introduction to the Theory of Fuzzy Sub sets, Academic Press, New York, 1975. 3. V. Novak, Fuzzy Sets and Their Applications, Adam Hilger ,Bristol, 1969.
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO 1: Understand the concepts of fuzzy sets and its types

CLO 2: Distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function.

CLO 3: To knows fuzzy intersection – t norms, fuzzy unions and t- co norms.

CLO 4: Apply the concepts of a fuzzy number and apply in real world problems.

CLO 5: Students practice to construct various methods fuzzy sets using sample data.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	3	3	3	3	3	3	3	3
CLO 2	3	2	2	1	2	2	3	2	3
CLO 3	3	3	3	2	3	3	3	3	3
CLO 4	3	1	3	3	3	3	3	2	3
CLO 5	3	2	3	3	3	3	3	3	3

Title of the Course		**MATHEMATICAL PROGRAMMING**					
Paper Number		**ELECTIVE - II**					
Category	Elective	**Year**	I	**Credits**	3	**Course Code**	23KP1MECM2:2
		Semester	I				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	I		--	5	
Objectives of the Course		This course introduces advance topics in Linear and non - linear Programming					
Course Outline		**UNIT I : INTEGER LINEAR PROGRAMMING:** Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory's All Integer Cutting Plane Method - Gomory's mixed Integer Cutting Plane method- Branch and Bound Method. 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-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints Non-linear Programming Methods : Examples of NLPP - General NLPP - Graphical solution – Quadratic Programming-Wolfe's modified Simplex Methods-Beale's Method Chapter-23: 23.1-23.4 Chapter-24: 24.1-24.4					
		UNIT III: THEORY OF SIMPLEX METHOD: Canonical and Standard form of LP - S lack 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 - Computational procedure for Standard form I-comparison of simplex method and Revised simplex Method. Bounded Variables LP problem: The simplex algorithm Chapter-26:26.1-26.4Chapter-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					
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					

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 UniversityPress,1997.(Indian Edition) 3. I.S. Luther andI. 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

CLO 1: Prove theorems applying algebraic ways of thinking.

CLO 2: Connect groups with graphs and understanding about Hamiltonian graphs.

CLO 3: Compose clear and accurate proofs using the concepts of Galois Theory.

CLO 4: Bring out insight into Abstract Algebra with focus on axiomatic theories.

CLO 5: 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
CLO 1	3	1	3	2	3	3	3	2	1
CLO 2	2	1	3	1	3	3	3	2	1
CLO 3	3	2	3	1	3	3	3	2	1
CLO 4	1	2	3	2	3	3	3	2	1
CLO 5	3	1	2	3	3	3	3	2	1

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Title of the Course	**REAL ANALYSIS II**						
Paper Number	**CORE V**						
Category	Core	**Year**	I	**Credits**	5	**Course Code**	23KP2M05
		Semester	II				
Instructional Hours Per week	**Lecture**		**Tutorial**		**Lab Practice**	**Total**	
	5		1		--	6	
Pre-requisite	Elements of Real Analysis						
Objectives of the Course	To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals. in-depth study in Multi variable calculus.						
Course Outline	**UNIT I: Measure on the Real line** - Lebesgue Outer Measure- Measurablesets – Regularity –Measurable Functions - Boreland Lebesgue Measurability **Chapter-2 : 2.1 - 2.5 (de Barra)**						
	UNIT II : Integration of Functions of a Real variable – Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals **Chapter-3 :3.1, 3.2and3.4 (de Barra)**						
	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 ortho normal system - Properties of Fourier Coefficients - The Riesz-Fischer Theorem – 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–Cesaro summability of Fourier series – Consequences of Fejes's theorem –The Weierstrass approximation theorem **Chapter11 : 11.1 - 11.15 (Apostol)**						
	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^ntoR^1 **Chapter12 : 12.1 - 12.14 (Apostol)**						

	UNIT-V: Implicit Functions and Extremum Problems: Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem- Extrema of real valued functions of sever able variables - Extremum problems with side conditions. **Chapter13 :Sections 13.1 -13.7 (Apostol)**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations 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. deBarra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II) 2. Tom M. Apostol :*Mathematical Analysis*, 2nd Edition, Addison-WesleyPublishingCompanyInc.NewYork,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, NewYork,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 BansiLal, *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

CLO 1: Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system.

CLO 2: Analyze the representation and convergence problems of Fourier series.

CLO 3: Analyze and evaluate the difference between transforms of various functions.

CLO 4: Formulate and evaluate complex contour integrals directly and by the fundamental theorem.

CLO 5: Apply the Cauchy integral theorem in its various versions to compute contour integration.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	1	3	2	3	3	3	2	1
CLO 2	2	1	3	1	3	3	3	2	1
CLO 3	3	2	3	1	3	3	3	2	1
CLO 4	1	2	3	2	3	3	3	2	1
CLO 5	3	1	2	3	3	3	3	2	1

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Title of the Course	PARTIAL DIFFERENTIAL EQUATIONS					
Paper Number	COREVI					
Category: Core	Year: I	Credits: 4	Course Code: 23KP2M06			
	Semester: II					
Instructional Hours Per week	Lecture: 5	Tutorial: 1	Lab Practice: --	Total: 6		
Pre-requisite	UG level partial differential equations					
Objectives of the Course	To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value Problems.					
Course Outline	**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 : 2.1 - 2.6** **Chapter 3: 3.1 - 3.4 (Omit3.5)**					
	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 – Riemannmethod–Goursatproblem–sphericalwaveequation–cylindricalwaveequation. **Chapter 4 : 4.1 - 4.11**					
	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 : 6.1 - 6.6 (Omit section 6.7)**					
	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 : 8.1 - 8.9**					
	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. **Chapter10 : 10.1 - 10.9**					

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations 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- UandLokenathDebnath,*PartialDifferentialEquationsforScientistsandEngineers*(ThirdEdition),NorthHollan,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, NewDelhi, 1983. 3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, NewYork, 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,NewDelhi.2004
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: To understand and classify second order equations and find general solutions

CLO 2: To analyze and solve wave equations in different polar coordinates

CLO 3: To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations

CLO 4: To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions

CLO 5: 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
CLO 1	3	1	3	2	3	3	3	2	1
CLO 2	2	1	3	1	3	3	3	2	1
CLO 3	3	2	3	1	3	3	3	2	1
CLO 4	1	2	3	2	3	3	3	2	1
CLO 5	3	1	2	3	3	3	3	2	1

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Title of the Course	STATISTICAL DATA ANALYSIS USING R-PROGRAMMING					
Paper Number	ELECTIVE - III					
Category: Elective	Year	I	Credits	3	Course Code	23KP2MEC M3:I
	Semester	II				
Instructional Hours Per week	Lecture	Tutorial	Lab Practice	Total		
	3	1	--	4		
Pre-requisite	Basic knowledge in Computer and Statistics					
Objectives of the Course	Developing our programe knowledge by using R-Tools software					
Course Outline	**UNIT I: Introduction to R programming:** What is R? - Installing R and R Studio – R Studio Overview –Working in the Console-Arithmetic Operators – Logical Operations - Using Functions - Getting Help in R and Quitting R Studio- Installing and loading packages. Data structures, variables, and data types in R:Creating Variables- Numeric,CharacterandLogicalData-Vectors-DataFrames-Factors-SortingNumeric,Character,andFactor Vectors-Special Values.					
	UNIT II: DataVisualizationusingR: ScatterPlots-BoxPlots-ScatterPlotsandBox-and-WhiskerPlotsTogether-Customizeplotaxes,labels, Add legends, and add colors.					
	UNIT III: Descriptive statistics in R : Measures of central tendency - Measures of variability -Skewness and kurtosis – Summary functions, describe functions, and descriptive statistics by group.					
	UNIT IV: Testing of Hypothesis using R:T-test, Paired Test, correlation, Chi-Square test, Analysis of Variance and Correlation					
	UNIT V: Predictive Analytics: linear Regression model, Non-Linear Least Square, multiple regression analysis, Logistic Regression, Panel Regression Analysis, ARCH Model, GARCH models, IF model.					
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)					
Recommended Text	1. Crawley, M.J.(2006), -Statistics-An introduction using R‖, John Wiley, London 32. 2. Purohit,S. G.; Gore, S. D. and Deshmukh, S.R. (2015) ,— Statistics using R‖, second edition. Narosa Publishing House, New Delhi. . Shahababa B.(2011) ,-Biostatistics with R‖, Springer, New York. 4. Braun & Murdoch (2007), —A first course in statistical programming with R‖, Cambridge University Press, and New Delhi.					
Website and e-Learning Source	. https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf 2. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/R/R-Manual/R-Manual2.html . https://smac-group.github.io/ds/ . https://www.geeksforgeeks.org/predictive-analysis-in-r					

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Install code and use R programming language in R studio IDE to perform basic tasks on data frames.

CLO 2: Learning the basic R- Language constructs.

CLO 3: To understand the descriptive statistics in R such as measures of central tendency, skewness kurtosis.

CLO 4: To understand the testing hypothesis for t - test, paired t-test and chi-square test using R- programming.

CLO 5: To design and build linear regression model.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	3	3	3	3	3	3	3	3
CLO 2	3	2	2	1	2	2	3	2	3
CLO 3	3	3	3	2	3	3	3	3	3
CLO 4	3	1	3	3	3	3	3	2	3
CLO 5	3	2	3	3	3	3	3	3	3

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Department of Mathematics,
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THANJAVUR-613 007.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Install code and use R programming language in R studio IDE to perform basic tasks on frames.

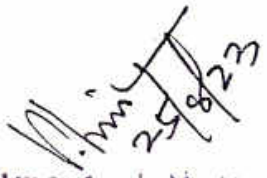
CLO 2: Learning the basic R- Language constructs.

CLO 3: To understand the descriptive statistics in R such as measures of central tendency, skewr kurtosis.

CLO 4: To understand the testing hypothesis for t - test, paired t-test and chi-square test using R- programming.

CLO 5: To design and build linear regression model.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	3	3	3	3	3	3	3	3
CLO 2	3	2	2	1	2	2	3	2	3
CLO 3	3	3	3	2	3	3	3	3	3
CLO 4	3	1	3	3	3	3	3	2	3
CLO 5	3	2	3	3	3	3	3	3	3



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<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">TENSOR ANALYSIS AND RELATIVITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE - III</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>23KP2MICM3:2</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>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The course aims to introduce vector algebra and vector calculus andspecialrelativityandrelativistickinematics,dynamicsandaccelerated systems.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I: TENSOR ALGEBRA Systems of Different orders-SummationConvention-KroneckerSymbols-Transformationofcoordinates in Sn - Invariants - Covariant and Contra variant vectors –Tensors of Second Order- Mixed Tensors- Zero Tensor-Tensor Field
- Algebra of Tensors - Equality of Tensors - Symmetric and Skew – symmetrictensors-Outermultiplication,ContractionandInnerMultiplication-QuotientLawofTensors-ReciprocalTensorofTensor
- Relative Tensor – Cross Product of Vectors.

Chapter 1: .1.1 - I.3, 1.7 and I.8 and Chapter 2: 2.1 - 2.9</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit II: TENSOR CALCULUS Riemannian Space - Christ offel Symbols and their properties

Chapter 3: 3.1and 3.2</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit III: TENSOR CALCULUS (CONTD) Covariant Differentiation of Tensors – Riemann – Christ offel Curvature Tensor –Inrinsic Differentiation.
Chapter 3: 3.3-3.5</td></tr>
</table>

	Unit IV SPECIAL THEORY OF RELATIVITY Galilean Transformation-Maxwell's equations – The ether Theory-The Principleof Relativity. Relativistic Kinematics : Lorentz Transformation equations - Eventsandsimultaneity-Example-EinsteinTrain-Timedilation-Longitudinal Contraction - Invariant Interval - Proper time and Proper distance-World line-Example-twin paradox- addition of velocities Relativistic Doppler effect. **Chapter7**: 7.1-7.2
	Unit V: RELATIVISTIC DYNAMICS Momentum – Energy - Momentum - energy four vector - Force - Conservation of Energy – Mass and energy – Example – in elastic collision- Principle of equivalence - Lagrangian and Hamiltonian formulations. Accelerated Systems: Rocket with constant acceleration - example - Rocket with constant thrust. **Chapter 7** :7.3 - 7.4
Extended Professional Component	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge,ProblemSolving,Analyticalability,ProfessionalCompetency,Professional Communication and Transferrable Skill
Recommended Text	1. U. C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. 2.D.Greenwood,Classical Dynamics, Prentice Hall of India, NewDelhi,198

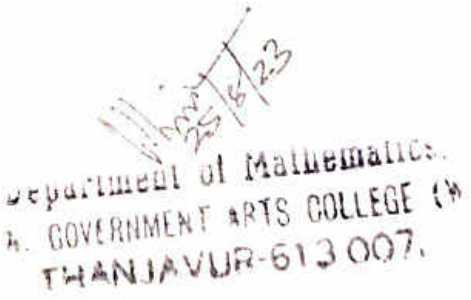
	Unit IV SPECIAL THEORY OF RELATIVITY Galilean Transformation-Maxwell's equations – The ether Theory-The Principleof Relativity. Relativistic Kinematics : Lorentz Transformation equations - Eventsandsimultaneity-Example-EinsteinTrain-Timedilation-Longitudinal Contraction - Invariant Interval - Proper time and Proper distance-World line-Example-twin paradox- addition of velocities Relativistic Doppler effect. **Chapter7**: 7.1-7.2
	Unit V: RELATIVISTIC DYNAMICS Momentum – Energy - Momentum - energy four vector - Force - Conservation of Energy – Mass and energy – Example – in elastic collision- Principle of equivalence - Lagrangian and Hamiltonian formulations. Accelerated Systems: Rocket with constant acceleration - example - Rocket with constant thrust. **Chapter 7** :7.3 - 7.4
Extended Professional Component	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge,ProblemSolving,Analyticalability,ProfessionalCompetency,Professional Communication and Transferrable Skill
Recommended Text	1. U. C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus. Narosa Publishing House, New Delhi, 2004. 2.D.Greenwood,Classical Dynamics, Prentice Hall of India, NewDelhi,198

Reference Books	1. J.L.SyngeandA.Schild,TensorCalculus,Toronto,1949. 2. A.S.Eddington.TheMathematicalTheoryofRelativity,CambridgeUniversity Press, 1930. 3. P. G. Bergman, An Introduction to Theory of Relativity, New York,1942 4. C. E. Weather burn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938.
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

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



Title of the Course		**WAVELETS**					
Paper Number		ELECTIVE– IV					
Category	Elective	**Year**	I	**Credits**	3	**Course Code**	23KP2MECM4:1
		Semester	II				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	1		--	4	
Pre-requisite		UG level Differential Equations, Fourier transform and Linear Algebra					
Objectives of the Course		To establish the theory necessary to understand and use wavelets and related Constructions.					
Course Outline		**UNIT I: Signals and Systems** Basic concepts of signals and systems, Frequency spectrum of signals; Classification of signals: Discrete time signals and continuous time signals, periodic and non-periodic signals; Classification of systems: Linear, Nonlinear, time-variant, time-invariant, stable and unstable systems.					
		UNIT II: Haar Scaling Function and Wavelet Time - Frequency Analysis Orthogonal functions, Ortho normal functions, Function spaces, Orthogonal basis functions, Haar scaling function, Haar spaces: Haar space, general Haar space V; Haar wavelet, Haar wavelet spaces: Haar wavelet space general Haar wavelet space ; Decomposition andreconstruction,Time-frequencyanalysis,Orthogonalandorthonormalbases					
		UNIT-III: Fourier Transforms and Wavelets Discrete Fourier transform of a digital signal, Complex form of a Fourier series, Inverse discrete Fourier transform, Window Fourier transform short time Fourier transform, Admissibility condition for a wavelet, Classes ofwavelets:Haar,Morlet,Maxicanhat,MeyerandDaubechieswavelets:Waveletswithcompactsupport.					
		UNIT-IV: Discrete Wavelet Transforms Stationary and non-stationary signals, Haar transform, 1-level Haar transform, Multi- level Haar transform , Conservation and compaction of energy, Multi resolution analysis, Decomposition and reconstruction of signals using discrete wavelet transform(DWT).					
		UNIT-V: Applications Wavelet series expansion using Haar and other wavelets, Applications in Signal compression, Analysis and classification of audio signals using DWT, Signal de-noising: Image and ECG signals					
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		Charles K. Chui, An Introduction to Wavelets. Academic Press, 1992.					

Reference Books	1. Ingrid Daubechies, Ten Lectures on Wavelets. SIAM, 1999. 2. Michael W. Frazier, an Introduction to Wavelets through Linear Algebra. Springer - Verlag, 1999. 3. Stéphane Mallat, A Wavelet Tour of Signal Processing (3rd edition).Academic Press, 2008. 4. M.J. Roberts, Signals and Systems: Analysis Using TransformMethodsandMATLAB.McGraw-HillEducation,2004 5. David K. Ruch & Patrick J. Van Fleet, Wavelet Theory: An Elementary Approach with Applications. John Wiley & Sons, 2009 6. James S. Walker, A Primer on Wavelets and Their ScientificApplications(2ndedition).Chapman&Hall/CRC,Taylor&Francis, 2008.
Website and e-Learning Source	1. https://archive.nptel.ac.in/courses/108/101/108101093/ 2. https://onlinecourses.nptel.ac.in/noc23_ee32/preview

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO 1: Know basic concepts of signals and systems.

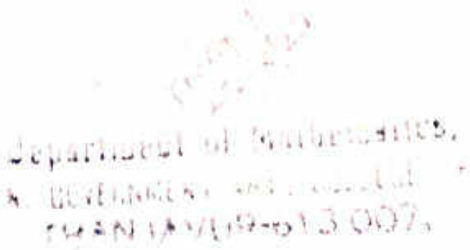
CLO 2: Understand the concept of Haar spaces.

CLO 3: Learn Fourier transform and wavelet transform of digital signals.

CLO 4: Learn application so wavelets to the real – world problems.

CLO 5: Apply wavelets in signal processing and image processing.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	1	2	2	3	2	3	3	2
CLO 2	2	3	2	3	2	2	3	3	2
CLO 3	3	3	3	3	3	2	3	3	3
CLO 4	3	2	3	3	2	2	3	3	2
CLO 5	3	2	3	3	2	2	3	2	3



Title of the Course		**NEURAL NETWORKS**					
Paper Number		**ELECTIVE - IV**					
Category	Elective	**Year**	I	**Credits**	3	**Course Code**	23KP2MECM4E2
		Semester	II				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	1		--	4	
Pre-requisite		UG level					
Objectives of the Course		Enable students to understand important concepts and theories of artificial neural networks (ANNs) enable students to understand how ANNs can be designed and trained enable students to calculate simple examples of ANNs					
Course Outline		**UNIT I:** Introductory Concepts: Neurons' and their basic function- Mathre view –Mathematical Machinery and Review – How and Why Perceptron's Can Compute Logic Statements- Training Perceptron's Using Supervised Learning Techniques - Training Multi –layer.					
		UNIT II: Neural Networks Using Supervised Learning Techniques: Recurrent Neural Networks and Unsupervised Learning: Optimization Techniques-Implementation and Performance Considerations-Variations on the Hopfield Network-A Stochastic Version of the Hopfield Network:					
		UNIT III: The Boltzmann Machine-A Stochastic Version of the Binary Associative Memory: Restricted Boltzmann Machines-Competitive Learning and Self-Organizing Maps-Neural Network Modifications and Applications-CellularNeuralNetworksandtheFutureofMassivelyParallel Computation					
		UNIT IV: Introduction to Machine Learning Techniques: Types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, over fitting.					
		UNIT V: Support Vector Machine, Kernel function and Kernel SVM. Neural network: Perceptron, multilayer network, back propagation, introduction to deep neural network.					
Extended Professional Component		Questions related to the above topics, from various competitive examinations UPSC/TNPSC/others to be solved (To be discussed during the Tutorial hour)					
Skills acquired from this course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
Recommended Text		1. Raul Rojas, Neural Networks - A Systematic Introduction, Springer-Verlag, Berlin, New York, 1996. 2. Koch, Christof, Biophysics of Computation: Information Processing In Single Neurons, OxfordUniversityPress,2004.					

Title of the Course		NEURAL NETWORKS					
Paper Number		ELECTIVE - IV					
Category	Elective	Year	I	Credits	3	Course Code	23KP2MECM4:2
		Semester	II				
Instructional Hours Per week		Lecture		Tutorial		Lab Practice	Total
		3		1		--	4
Pre-requisite		UG level					
Objectives of the Course		Enable students to understand important concepts and theories of artificial neural networks (ANNs) enable students to understand how ANNs can be designed and trained enable students to calculate simple examples of ANNs					
Course Outline		**UNIT I:** Introductory Concepts: Neurons' and their basic function- Mathre view –Mathematical Machinery and Review – How and Why Perceptron's Can Compute Logic Statements- Training Perceptron's Using Supervised Learning Techniques - Training Multi –layer.					
		UNIT II: Neural Networks Using Supervised Learning Techniques: Recurrent Neural Networks and Unsupervised Learning: Optimization Techniques-Implementation and Performance Considerations-Variations on the Hopfield Network-A Stochastic Version of the Hopfield Network:					
		UNIT III: The Boltzmann Machine-A Stochastic Version of the Binary Associative Memory: Restricted Boltzmann Machines-Competitive Learning and Self-Organizing Maps-Neural Network Modifications and Applications-CellularNeuralNetworksandtheFutureofMassivelyParallel Computation					
		UNIT IV: Introduction to Machine Learning Techniques: Types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, over fitting.					
		UNIT V: Support Vector Machine, Kernel function and Kernel SVM. Neural network: Perceptron, multilayer network, back propagation, introduction to deep neural network.					
Extended Professional Component		Questions related to the above topics, from various competitive examinations UPSC/TNPSC/others to be solved (To be discussed during the Tutorial hour)					
Skills acquired from this course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
Recommended Text		1. Raul Rojas, Neural Networks - A Systematic Introduction, Springer-Verlag, Berlin, New York, 1996. 2. Koch, Christ of, Biophysics of Computation: Information Processing In Single Neurons, OxfordUniversityPress,200-4.					

Reference Books	1. G. Dreyfus, Neural Networks Methodology and Applications, Springer, Berlin, Heidelberg, 2004. 2. James A. Freeman David M. Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Addison-Wesley Publishing Company, New York,1991.
Website and e-Learning Source	1. https://nptel.ac.in/courses/117105084 2. https://www.digimat.in/nptel/courses/video/127105006/L01.html 3. https://www.youtube.com/watch?v=NeMAxhDvSak&list=PLgMDNELGJ1CZn1399dV7_U4VBNJflRsua 4. https://www.youtube.com/watch?v=QlhHqMnd9Wo

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO 1: Learn different types of neural networks and different types of learning models

CLO 2: Determine the mathematical foundations of neural network models.

CLO 3: Implement of neural networks using training algorithms such as the feed-forward, back-propagation algorithm.

CLO 4: Design neural networks for practical purposes.

CLO 5: Build neural networks for practical purposes.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	2	2	2	2	2	3	3	2
CLO 2	2	1	2	1	3	2	3	3	3
CLO 3	3	2	2	2	2	3	2	2	2
CLO 4	2	2	2	2	2	2	3	2	2
CLO 5	3	1	2	2	3	3	2	2	2

CONTROLLER OF EXAMINATIONS
25 AUG 2023
A.V.C. Govt. Arts College for Women (Autonomous)

25/8/23
Department of Mathematics
A. GOVERNMENT ARTS COLLEGE (W)
THANJAVUR-613 007.

Title of the Course	ADVANCED LATEX					
Paper Number	SEC -I					
Category: SEC	Year	I	Credits	2	Course Code	23KP2MSEC1
	Semester	II				
Instructional Hours Per week	Lecture	Tutorial	Lab Practice	Total		
	3	1	--	4		
Pre-requisite						
Objectives of the Course	The course aims To create understanding of the LaTeX ➢ To type set typical mathematical papers using the article style and figure out LaTeX errors, download and use packages, create simple diagrams. To prepare a short presentation using the beamer class.					
Course Outline	**Unit I : Introduction and the Structure of a LaTeX Document** Installation of the software LaTeX - Environments and commands - Classes and packages – Errors - Files created - How to use LAEX at CUED - Document Classes - Arara- Counters and Length parameters – Document and page organization–Page breaks, footnotes. Environments, Matrix-like environments. Chapter - 1 and 2 in I &Chapter-1inII;Chapter–4inI&Chapter–5inII;Chapter-8 (Section8.3) in III					
	Unit II: Display and alignment structures Display and alignment structures for equations Comparison with standard LaTeX - A single equation on one line - A single equation on several lines: no alignment - A Single equation on several lines: with alignment – Equation groups without alignment - Equation groups with simple alignment – Multiple alignments: align and flalign - Display environments as mini-pages- Interrupting displays. Variable symbol commands-Symbols in formulas Chapte r–8 (Section8.2,8.5, 8.6 and8.9) in III					

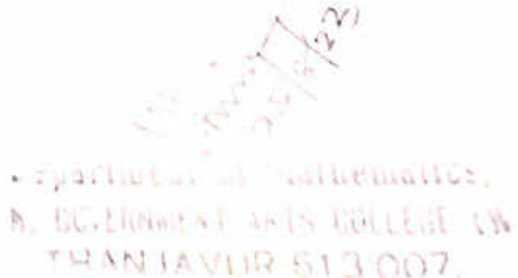
	Unit III: Figures Directly in LaTex Inserting Images, Positioning Images, List of Figures, Drawing diagrams directly in LaTex, TikZ package, Graphics and PS Tricks Pictures and graphics in LaTeX, simple picture suing PS Tricks, Plotting of functions.
	Unit IV: Presentations (The beamer Class) Overlays - Themes Assignments and Examinations The exam Class - The exceeds Package- The prison Package - Using the data tool Package for Exams or Assignment Sheets - Random Numbers. Charts Flow Charts - Pie Charts - The data pie Package - The pgf-pie Package – Bar Charts – The b chart Package-The data bar Package – Gantt Charts -Plots. Chapter– 8, 9and 12inII.
	Unit V: Structuring Your Document Author and Title Information, Abstract, Chapters, Sections, Subsections, Creating a Table of Contents, Cross-Referencing, Creating a Bibliography, Page Styles and Page Numbering, Multi-Lingual Support :using the Babel package. (5.1-5.7)
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	I. AdvancedLATEXbyTimLove,2006 II.http://www.h.eng.cam.ac.uk/help/documentation/docsource/latex_advanced.pdf III. LaTeX for Administrative Work by Nicola L. C. Talbot, DickimawBooks,2015,http://www.dickimaw-books.com/latex/admin/ IV. The LaTeX Companion by Frank Mittelbach and Michel Goossens, Addison-Wesley, Library of Congress Cataloging-in-Publication Data (Second Edition) V. Nicola L. C. Talbot, LATEX for Complete Novices Version 1.4, Dickimaw Bookshttp://www.dickimaw-books.com/2012.

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

Learning Outcomes:

This course will enable the students to:

- Create and typeset a LaTeX document.
- Type set a mathematical document.
- Draw pictures in LaTeX.
- Create beamer presentations.
- Prepare the projects or dissertations in LaTeX.



Title of the Course		CSIR - NET / SET Preparatory Course I					
Paper Number		ECC - I					
Category	ECC	Year	I	Credits	3	Course Code	23KP2MECC1:I
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		-	-		--	-	
Pre-requisite		Algebraic Structures					
Objectives of the Course		In this paper, the learner is mostly self directed and is responsible for his or her own learning. In this method, the instructors facilitate the learning of participants and help them by offering opportunities to learn themselves and acquire new knowledge.					

Course Outline

UNIT I: BASIC CONCEPTS OF LINEAR ALGEBRA

Space of n-vectors, Linear dependence, Basic, Linear Transformation, Algebra of Matrices, Rank of a Matrix, Determinants, Linear equations, Quadratic forms, Characteristic roots and vectors.

ALGEBRA: Permutations, combinations, pigeon - hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruence's, Chinese Remainder Theorem, Euler's Ø - function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homeomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory.

UNIT II : ANALYSIS

Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, lim sup, lim inf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, and derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Title of the Course		INTRODUCTION TO MATLAB (ADD ON COURSE)					
Paper Number		ECC -2					
Category	ECC	Year	I	Credits	4*	Course Code	23KP2MECC2
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		-	-		--	-	
Pre-requisite							
Objectives of the Course		Introduce common approaches, structures and conventions for creating and evaluating computer programs, primarily in a procedural paradigm, but with a brief introduction to object – oriented concepts and terminology. Introduce the MATLAB software environment.					
Course Outline		**UNIT I :STARTING WITH MATLAB** Starting MATLAB, MATLAB windows – working in the command window – arithmetic operations With scalars – display formats – elementary math built – in functions – defining scalars variables – Useful commands for managing variables – script files – examples of MATLAB applications. **Chapter 1: 1.1 - 1.9 (Pages : 1 -27)**					
		UNIT II CREATING ARRAYS: Creating a one – dimensional array – creating a two – dimensional array – notes about variables in MATLAB – the transpose operator. **Chapter 2: 2.1 - 2.4 (Pages: 35 – 41).**					
		UNIT III CREATING ARRAYS: Array addressing – using a colon : in addressing array – adding elements to existing variables – deleting Elements – built in functions for handling arrays **Chapter 2: 2.5 - 2.10 (Pages : 42 -55)** **PROGRAMMING IN MATLAB:** Relational and logical operators – conditional statements – the switch – case statement – loops –nested Loops and nested conditional statements – the break and continue commands – examples of MATLAB applications. **Chapter 6: 6.1 - 6.7 (Pages: 173 – 209)**					

	UNIT IV :MATHEMATICAL OPERATIONS WITH ARRAYS: Mathematical operations With arrays : addition and subtraction – array multiplication – array division – element – by – element operations **Chapter 3: 3.1 - 3.4** **MATHEMATICAL OPERATIONS WITH ARRAYS** Using arrays in MATLAB built – in math functions – built in functions for analyzing arrays – generation of random numbers – examples of MATLAB applications. **Chapter 3: 3.5 - 3.8** **TWO – DIMENSIONAL PLOTS:** The plot command – the *fplotcomm. and* - plotting multiple graphs in the same plot – formatting a plot – plots with logarithmic axes – plots with error bars – plots with special graphics – histograms – polar plots- putting multiple plots on the same page – multiple figure windows – examples of MATLAB Applications. **Chapter 5: Sections 5.1 to 5.12(Pages:133-163)**
	UNIT V : POLYNOMIALS AND CURVE FITTING: Polynomials – curve fitting **APPLICATIONS IN NUMERICAL ANALYSIS:** Numerical Integration – ordinary differential equations – examples of MATLAB applications (up to sample problem 9-4) **Chapter 8: 8.1 - 8.2 (Pages:261 -274)** **Chapter 9: 9.3 - 9.5 (Pages : 300 – 309)**
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	"MATLAB – An Introduction with Application" by AMOS Gilat, John Wiley & Sons, Singapore, 2011.
Reference Books	1. Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers" by R.Pratap, Oxford University Press, New Delhi, 2006. 2. Introduction to Matlab 7 for Engineers" by **W.J.Palm,** McGraw – Hill Education, New York, 2005. 3. Introduction to MATLAB 7" by D. M. **Etter,** D.C. Kuncicky and H. Moore, Prentice Hall, New Jersy, 2004.

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO 1: Use MATLAB effectively to analyze and visualize data.

CLO 2: Apply numeric techniques and computer simulations to solve engineering-related problems.

CLO 3: Design and document computer programs and analyzes in a careful and complete manner so a to effectively communicated results.

CLO 4: To facilitate evaluation and debugging by another programmer, and to anticipate and resolve user errors.

CLO 5: Demonstrate understanding and use of fundamental data structures.

CO-PO Mapping with Programme Outcomes:

MATLAB PROGRAMMING

CO / PO	1	2	3	4	5	6	7	8	9	10
1				3		2		2		
2					2	3		2		
3				2	2	3			2	
4					2	2		3		2
5				2		2		3	2	2

1-Low, 2- Moderate, 3 – High Correlation

CONTROLLER OF EXAMINATIONS
25 AUG 2023

Department of Mathematics,
GOVERNMENT ARTS COLLEGE (A
THANJAVUR-613 007.

Title of the Course	COMPLEX ANALYSIS					
Paper Number	CORE VII					
Category: Core	Year: II		Credits: 5		Course Code: 23KP3M07	
	Semester: III					
Instructional Hours Per week	Lecture: 5	Tutorial: 1	Lab Practice: --	Total: 6		
Pre-requisite	UG level Complex Analysis					
Objectives of the Course	To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of Definite integral and harmonic functions					
Course Outline	**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 to2.3** **Chapter 4 : Section 3 :3.1 to3.4**					
	UNIT-II: The general form of Cauchy's Theorem: Chains and cycles - Simple Continuity -Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials - Multiply connected regions - Residue theorem - The argument principle. **Chapter4 : Section 4: 4.1 to 4.7** **Chapter4 : Section 5: 5.1and5.2**					
	UNIT-III: Evaluation of Definite Integrals and Harmonic Functions Evaluation of definite integrals -Definition of Harmonicfunctionandbasicproperties-Meanvalueproperty-Poissonformula. **Chapter4 : Section 5 : 5.3** **Chapter4 : Sections 6: 6.1 to6.3**					
	UNIT-IV: Harmonic Functions and Power Series Expansions: Schwarz theorem –The reflection principle – Weierstrass theorem– Taylor's Series –Laurent series. **Chapter4 : Sections 6.4 and6.5** **Chapter5 : Sections1.1 to 1.3**					
	UNIT-V:Partial Fractions and Entire Functions: Partial fractions -Infinite products- Canonical products – Gamma Function-Jensen's formula– Hadamard's Theorem **Chapter5 : Sections2.1 to 2.4** **Chapter5 : Sections 3.1 and3.2**					

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from This course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Lars V. Ahlfors, *Complex Analysis*,(3rd edition) McGraw Hill Co., NewYork,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 PublishingCo.1978 3. E. Hille, *Analytic function Theory* (2 vols.), Gonm & Co, 1959. 4. M.Heins, *Complex function Theory*, Academic Press, NewYork,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

CLO 1: Analyze andevaluatelocalpropertiesofanalyticalfunctionsanddefiniteintegrals.

CLO 2: Describe the concept of definite integral and harmonic functions.

CLO 3: Demonstrate the concept of the general form of Cauchy's theorem.

CLO 4: Develop Taylor and Laurent series

CLO 5: 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

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from This course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Lars V. Ahlfors, *Complex Analysis*,(3rd edition) McGraw Hill Co., NewYork,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 PublishingCo.1978 3. E. Hille, *Analytic function Theory* (2 vols.), Gonm & Co, 1959. 4. M.Heins, *Complex function Theory*, Academic Press, NewYork,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

CLO 1: Analyze andevaluatelocalpropertiesofanalyticalfunctionsanddefiniteintegrals.

CLO 2: Describe the concept of definite integral and harmonic functions.

CLO 3: Demonstrate the concept of the general form of Cauchy's theorem.

CLO 4: Develop Taylor and Laurent series

CLO 5: 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

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Title of the Course		**PROBABILITY THEORY**					
Paper Number		**CORE VIII**					
Category	Core	**Year**	II	**Credits**	5	**Course Code**	23KP3M08
		Semester	III				

Instructional Hours Per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	5	1	--	6

Pre-requisite	UG level algebra and calculus
Objectives of the Course	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.
Course Outline	**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: 1.1 - 1.7** **Chapter 2 : 2.1 - 2.9**
	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 : 3.1 - 3.8**
	UNIT III: Characteristic functions: Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multi dimensional random vectors– Probability generating functions. **Chapter 4 : 4.1 - 4.7**
	UNIT IV: Some Probability distributions: One point, two point, Binomial – Polya–Hyper geometric–Poisson(discrete)distributions –Uniform–normal gamma–Beta–Cauchy and Laplace (continuous) distributions. **Chapte r 5 : 5.1 - 5.10 (Omit Section 5.11)**
	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: 6.1 - 6.4, 6.6 - 6.9, 6.11 and 6.12 .(Omit Sections 6.5, 6 .10, 6.13 to 6.15)
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from This course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M.Fisz, *Probability Theory and Mathematical Statistics,* John Wiley And Sons, New York,1963.
Reference Books	1. R.B. Ash, *Real Analysis and Probability*, Academic Press, NewYork,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. 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,*ModernProbabilityTheory*(3rd Edition),NewAgeInternatio nal(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

CLO 1: 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.

CLO 2: To define Expectation, Moments and Chebyshev Inequality, to solve Regression of the first and second types.

CLO 3: To define Characteristic functions, to define distribution function, to find probability generating functions, to solve problems applying characteristic functions

CLO 4: To define One point, two-point, Binomial distributions, to solve problems of Hyper geometric and Poisson distributions, to define Uniform, normal, gamma, Beta distributions, to solve problems on Cauchy and Laplace distributions.

CLO 5: 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
CLO 1	3	1	3	2	3	3	3	2	1
CLO 2	2	1	3	1	3	3	3	2	1
CLO 3	3	2	3	1	3	3	3	2	1
CLO 4	1	2	3	2	3	3	3	2	1
CLO 5	3	1	2	3	3	3	3	2	1

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Department of Mathematics.
GOVERNMENT ARTS COLLEGE (A
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Title of the Course	TOPOLOGY					
Paper Number	CORE IX					
Category: Core	Year: II	Credits: 5	Course Code: 23KP3M09			
	Semester: III					
Instructional Hours Per week	Lecture: 5	Tutorial: 1	Lab Practice: --	Total: 6		
Pre-requisite	Real Analysis					
Objectives of the Course	To study topological spaces, continuous functions, connectedness, Compactness, count ability and separation axioms.					
Course Outline	**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 limits points. **Chapter2 : Sections 12 to17**					
	UNIT-II: Continuous functions: Continuous functions–the product topology– The metric topology. **Chapter2 :Sections 18to21 (Omit Section 22)**					
	UNIT-III: Connectedness: Connected spaces-connected subspaces of the Real line – Components and local connectedness. **Chapter3: Sections 23 to25.**					
	UNIT-IV: Compactness: Compact spaces – compact subspaces of the Real line– Limit Point Compactness– Local Compactness. **Chapter3: Sections 26 to29.**					
	UNIT-V: Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma –The Urysohn metrization Theorem –The Tietz extension theorem. **Chapter4 : Sections 30 to35.**					
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations 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	James R. Munkres, *Topology* (2nd Edition) Pearson Education Pvt. Ltd.,Delhi-2002 (Third Indian Reprint)					

Title of the Course	MECHANICS						
Paper Number	CORE X						
Category Core	**Year**	II	**Credits**	4	**Course Code**	23KP3M10	
	Semester	III					
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**	**Total**	
	5		1		--	6	
Pre-requisite	UG level Calculus and Differential equations.						
Objectives of the Course	To study mechanical systems under generalized coordinate systems virtual work, energy and momentum, to study mechanics developed by Newton, Langrange, Hamilton Jacobi and Theory of Relativity due to Einstein.						
Course Outline	**UNIT-I :** Mechanical Systems : The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum **Chapter 1 : Sections 1.1 to 1.5**						
	UNIT-II : Lagrange's Equations: Derivation of Lagrange equations- Examples- Integrals of motion. **Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4)**						
	UNIT-III : Hamilton's Equations : Hamilton's Principle - Hamilton Equation - Other variational principle. **Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)**						
	UNIT – IV : Hamilton-Jacobi Theory : Hamilton Principle function – Hamilton-Jacobi Equation - Separability **Chapter 5 : Sections 5.1 to 5.3**						
	UNIT-V : Canonical Transformation : Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets. **Chapter 6 : Sections 6.1, 6.2 and 6.3 (omit sections 6.4, 6.5 and 6.6)**						
Extended Professional Component(is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)						
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Profession Competency, Professional Communication and Transferrable Skill						
Recommended Text	D. Greenwood, *Classical Dynamics*, Prentice Hall of India, New Delhi, 1985.						

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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Demonstrate the knowledge of core principles in mechanics.

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

CLO3: Apply the variation principle for real physical situations.

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

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

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

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VUR-613 007.

Title of the Course		STOCHASTIC PROCESSES					
Paper Number		ELECTIVE – V					
Category	Elective	Year	II	Credits	3	Course Code	23KP3MECM5:1
		Semester	III				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	1		--	3	
Pre-requisite		Elements of Probability Theory					
Objectives of the Course		To provide students with a strong foundation in Probability distribution with time series analysis, focusing on discrete and continuous.					
Course Outline		**UNIT I:** Introduction to stochastic process (SP) – classification of SP according to state space and time domain. Countable state markov chain (MC). Chapman- Kolmogorov equations. Calculation of 'n' step transition probability.					
		UNIT II: Discrete state space –continuous time MC. Kolmogorov differential equations. Poisson process, birth and death process .Application to queues and storage problem. Random walk.					
		UNIT III: Markov process–continuous time and continuous state space - time homogenous markov process – Kolmogorov's equation. Wiener process as a limit of random walk, first passage time Diffusion process with Wiener process.					
		UNIT IV: Stationary process and time series- wide sense and strict sense stationary process – moving average and auto regressive process. Covariance function- Bochner's function (statement), Khintchine's representation of wide sense stationary process.					
		UNIT V: Renewal theory – renewal function and its properties– Elementary and key renewal theorems.					
Extended Professional Component		Questions related to the above topics, from various competitive examinations UPSC/TNPSC/others to be solved (To be discussed during the Tutorial hour)					

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Medhi. J. (1982) Stochastic processes, Wiley Eastern. 2. Basu.A.K.(2003)Introductiontostochasticprocesses,NewsaPublishingHouse.
Reference Books	1. Ross. S .M.(1983) Stochastic Process, Wiley, New York. 2. Karlin and First course in Stochastic Process -Vol. I & II, Academic Press. Taylor. H.M. (1975)
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 understand the Markov chain and determine the n step transition probability.

CLO 2: To classify Poisson, Markov birth and death process.

CLO 3: To understand the Markov process.

CLO 4: To understand the stationary process like wide sense and strict sense stationary process.

CLO 5: To understand the renewal process.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	3	3	3	3	3	3	3	3
CLO 2	3	2	2	1	2	2	3	2	3
CLO 3	3	3	3	2	3	3	3	3	3
CLO 4	3	1	3	3	3	3	3	2	3
CLO 5	3	2	3	3	3	3	3	3	3

25/4/23

Department of Mathematics
GOVERNMENT ARTS COLLEGE
THANJAVUR-613 007.

Title of the Course	FLUID DYNAMICS					
Paper Number	ELECTIVE - V					
Category: Elective	Year	II	Credits	3	Course Code	23KP3MECM5:2
	Semester	III				
Instructional Hours Per week	Lecture	Tutorial		Lab Practice	Total	
	2	1		--	3	
Pre-requisite	Elements of Mechanics.					
Objectives of the Course	To provide students with a strong knowledge in Mechanics, focusing on Real fluids, Ideal fluids and Motion of a Fluid. To develop student's skills and confidence in mathematical analysis and proof techniques.					
Course Outline	**UNIT I: Kinematics of Fluids in Motion:** Real fluids and Ideal fluids - Velocity of a fluid at a point –Stream lines and path lines -Steady and Unsteady flows - The Velocity Potential - The VorticityVector-LocalandParticleRatesofChange-TheEquationofContinuity-WorkedExamples. (Chapter2:Sections2.1-2.8).					
	UNIT II: Equations of Motion of a Fluid: Pressure at a point in afluidatrest-Pressureatapointinamovingfluid-Euler'sequationsofMotion-Bernoulli'sequation-WorkedExamples-Discussionofthe case of steady motion under Conservative Body Forces – Some flows involving axial symmetry (examples1and 2 only). (Chapters3: Sections 3.1, 3.2,3.4-3.7, 3.9).					
	UNIT III: Some Three-Dimensional Flows: Introduction - Sources, Sinks and Doublets-Images in rigid infinite plane - Images in solid spheres – Axis symmetric flows. (Chapter4: Sections 4.1-4.4).					
	UNIT IV: Some Two-Dimensional Flows: The Stream Function - TheComplexVelocityPotentialforTwoDimensionalIrrotational,IncompressibleFlow-ComplexVelocityPotentialsforStandardTwoDimensional Flows - Some Worked Examples - Two Dimensional Image Systems - The Milne-Thomson Circle Theorem.(Chapter5: Sections 5.3-5.8).					

	UNIT V Viscous Fluid: Stress components in a real fluid – Relation between Cartesian Components of Stress- Translational motion of fluid element – The Coefficient of Viscosity and Laminar flow – The Navier- Stokes equation of a viscous fluid - Some solvable problems in viscous flow - Steady motion between parallel planes only. (Chapter 8:Sections8.1-8.3, 8.8, 8.9 and 8.10.1).
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, ProblemSolving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.FrankChorlton,Textbook of Fluid Dynamics, CBS Publishers & Distributors, 2004.
Reference Books	1. L. M. Milne-Thomson, Theoretical Hydro dynamics, Macmillan, London, 1955. 2. G.K. Batchelor, An Introduction to Fluid Dynamics Cambridge Mathematical Library, 2000.
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 the fluid particles in steady and unsteady compressible and incompressible flows.

CLO2: Recognize these principles written in form of mathematical equation.

CLO3: To apply the basic knowledge of 3- dimensional potential flow.

CLO4: Apply two dimensional analyses to predict physical parameters that influence the flow in FD.

CLO5: Understand viscosity, Lamina flow, and viscous flow.

	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

25/6/23

Department of Mathematics.
N. GOVERNMENT ARTS COLLEGE (W),

Title of the Course	NUMERICAL ANALYSIS USING SCILAB					
Paper Number	SEC – 2					
Category: SEC	Year	II	Credits	2	Course Code	23KP3MSEC2
	Semester	III				
Instructional Hours Per week	Lecture	Tutorial		Lab Practice	Total	
	1			2	3	
Objectives of the Course	To developing the knowledge for numerical methods using **SCILAB**					
Course Outline	**UNIT I:** Transcendental and Polynomial Equations					
	UNIT II: System of Linear Algebraic Equations and Eigen value Problems					
	UNIT III: Interpolation and Approximation					
	UNIT IV: Differentiation and Integration					
	UNIT V: Ordinary Differential Equations Initial Value Problems					
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	Numerical Methods For Scientific And Engineering Computation by M. K. Jain,S. R. K. Iyengar And R. K.Jain.					
Reference Books	1.Numerical Methods and principles analysis and algorithms, S.Pal, Oxford University Press					
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com					

Department of Mathematics,
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THANJAVUR 613 007.

Title of the Course		CSIR- NET/SET PREPARATORY COURSE - II					
Paper Number		ECC 3					
Category	ECC	Year	II	Credits	3	Course Code	23KP3MECC3:1
		Semester	III				
Instructional Hours		Lecture	Tutorial		Lab Practice	Total	
Per week		-			-		
Objectives of the Course		In this paper, the learner is mostly self directed and is responsible for his or her own learning. In this method, the instructors facilitate the learning of participants and help them by offering opportunities to learn themselves and acquire new knowledge.					
Course Outline		**UNIT I : ORDINARY DIFFERENTIAL EQUATIONS (ODES)** Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm – Liouville boundary value problem, Green's function. **PARTIAL DIFFERENTIAL EQUATIONS (PDES):** Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.					
		UNIT II: NUMERICAL METHODS Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge -Kutta methods.					
		UNIT III: MECHANICS Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations. Variation principles least action; Two dimensional motion of rigid bodies; Euler's dynamical equations for the motion of rigid body; Motion					

	of a rigid body about an axis; Motion about revolving axes.
	UNIT IV: BASIC CONCEPTS OF PROBABILITY Sample space, discrete probability, simple theorem on probability, independence of events, Bayes Theorem. Discrete and continuous random variables, Binomial, Poisson and Normal distributions; Expectation and moments, independence of random variables, Chebyshev's inequality. Probability - Axiomatic definition of probability. Random variables and distribution functions (univeriate and multivariate); expectation and moments; independent events and independent random variables; Bayes' theorem; marginal and conditional distribution in the multivariate case, covariance matrix and correlation coefficients (product moment, partial and multiple), regression. Moment generating functions; characteristic functions; probability inequalities (Tchebyshef, Markov, Jenson). Convergence in probability and in distribution; weak law of large numbers and central limit theorem for independent identically distributed random variables with finite variance.
	UNIT V: NUMBER THEORY DIVISIBILITY Linear Diophantine equations. Congruence's. Quadratic residues; Sums of two squares, Arithmetic functions Mu, Tau, Phi and Sigma (and). **DIFFERENTIAL GEOMETRY:** Space Curves – Their Curvature and torsion , Serret Frehat Formula; Fundamental theorem of Space curves; curves on surfaces – First and Second fundamental form – Gaussian curvatures – Principal directions and Principal Curvatures, geodesics, Fundamental equations of surface theory. **TOPOLOGY:** Elements of Topological spaces – Continuity, Convergence, Homeomorphism, Compactness, Connectedness – Separation axioms – First and Second countability, Separately, Subspaces, Product space – Quotient spaces – Tychonoff's theorem – Urysohn's Metrization theorem – Homotopy and Fundamental Groups.
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	Kumaresan, Foundations in Mathematics.

Title of the Course	FUNCTIONAL ANALYSIS					
Paper Number	CORE XI					
Category: Core	Year: II	Credits: 5	Course Code: 23KP4M11			
	Semester: IV					
Instructional Hours Per week	Lecture: 5	Tutorial: 1	Lab Practice: --	Total: 6		
Pre-requisite	Elements of Real Analysis					
Objectives of the Course	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.					
Course Outline	**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**					
	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. **Chapter 10: Sections5 2-59**					
	UNIT III : Finite-Dimensional Spectral Theory: Matrices– Determinants and the spectrum of an operator –The spectral theorem. **Chapter 11:Sections 60-62**					
	UNIT IV: General Preliminaries on Banach Algebras: The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi-simplicity. **Chapter 12: Sections 64-69**					
	UNIT V: The Structure of Commutative Banach Algebras: The Gelfand mapping – Application of the formula $r(x) = \lim \|x^n\|^{1/n}$ –Involutions in Banach algebras –The Gelfand - Neumarktheorem. **Chapter 13: Sections 70-73**					

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)PrivateLimited,NewDelhi,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.ThambanNair, 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

CLO 1: Understand the Banach spaces and Transformations on Banach Spaces.

CLO 2: Prove Hahn Banach theorem and open mapping theorem.

CLO 3: Describe operators and fundamental theorems.

CLO 4: Validate orthogonal and ortho normal sets.

CLO 5: Analyze and establish the regular and singular elements.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	1	3	2	3	3	3	2	1
CLO 2	2	1	3	1	3	3	3	2	1
CLO 3	3	2	3	1	3	3	3	2	1
CLO 4	1	2	3	2	3	3	3	2	1
CLO 5	3	1	2	3	3	3	3	2	1

Title of the Course	DIFFERENTIAL GEOMETRY					
Paper Number	CORE XII					
Category: Core	Year: II		Credits: 5		Course Code: 23KP4M12	
	Semester: IV					
Instructional Hours Per week	Lecture: 5	Tutorial: 1	Lab Practice: --	Total: 6		
Pre-requisite	Linear Algebra concepts and Calculus					
Objectives of the Course	This course introduces space curves and their intrinsic properties of a surfaceandgeodesics.Furtherthenon-intrinsicpropertiesofsurfaceandthe differential geometry of surfaces are explored					
Course Outline	**UNIT I : Space curves:** Definition of a space curve – Arc length – tangent– normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes-Intrinsic equations – Fundamental Existence Theorem for space curves-Helies. **Chapter I: Sections1 to 9.**					
	UNIT II: Intrinsic properties of a surface: Definition of a surface – curves on surface – Surface of revolution – Helicoids–Metric-Direction coefficients – families of curves- Isometric correspondence-Intrinsic properties. **Chapter II: Sections1 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: Sections10 to18.**					
	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 1to 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 9to 15).**					

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from This course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	T. J. Willmore, *An Introduction to Differential Geometry,* Oxford University Press,(17th Impression)New Delhi2002.(Indian Print)
Reference Books	2. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950. 3. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry,* Inter science Publishers, 1963. 4. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978. 5. 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, metric son 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

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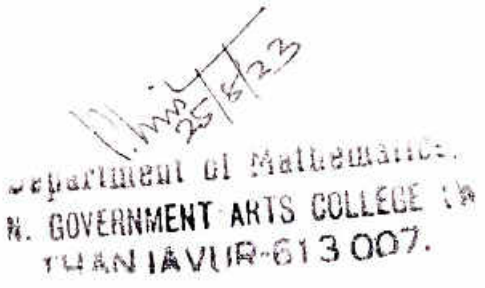
Title of the Course		PROJECT WITH VIVA VOCE					
Paper Number		CORE					
Category	Core	Year	II	Credits	7	Course Code	23KP4MPW
		Semester	IV				

Instructional Hours Per week	Lecture	Tutorial	Lab Practice	Total
	5	5	--	10

Pre-requisite	UG Level Mathematics



Title of the Course		**RESOURCE MANAGEMENT TECHNIQUES**					
Paper Number		**ELECTIVE -VI**					
Category	Elective	**Year**	II	**Credits**	3	**Course Code**	23KP4MECM6:1
		Semester	IV				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	1		--	4	
Pre-requisite		Elementary knowledge in Operation Research					
Objectives of the Course		This course introduces Linear, Integer , Multistage (Dynamic) Programming Networks problems.					
Course Outline		**UNIT I: LINEAR PROGRAMMING** Principal components of decision problem – Modeling phases – LP Formulation and graphic solution – Resource allocation problems – Simplex method – Sensitivity analysis.					
		UNIT II: DUALITY AND NETWORKS Definition of dual problem – Primal – Dual relationships –Dual simplex methods – Post optimality analysis – Transportation and Assignment model – Shortest route problem.					
		UNIT IIII: INTEGER PROGRAMMING Cutting plane algorithm – Branch and bound methods, Multistage (Dynamic) programming.					
		UNIT IV: CLASSICAL OPTIMISATION THEORY Unconstrained external problems, Newton – Ralphson method –Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.					
		UNIT V: OBJECT SCHEDULING Network diagram representation – Critical path method –Time charts and resource leveling – PERT.					
Extended Professional Component		Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TNPSC/others to be solved (To be discussed during the Tutorial hour)					
Skills acquired from this course		Knowledge,ProblemSolving,Analyticalability,ProfessionalCompetency,Professional Communication and Transferrable Skill					
Recommended Text		1. H.A. Taha, -Operation Research‖, Prentice Hall of India, 2002.					

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 McGraw 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

CLO 1: Understand the concept of the linear Programming problems.

CLO 2: Understand the concept of the artificial variable Technique and transportation problem.

CLO 3: Understand the concept of Integer Programming and Dynamic Programming.

CLO 4: Understand the solution for Non-linear Programming Problem by using Newton-Raphson method, Jacobian and Langrangian method.

CLO 5: Understand the concept of network programming by critical path method and PERT model.

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO 1	3	3	3	3	3	3	3	3	3
CLO 2	3	2	2	1	2	2	3	2	3
CLO 3	3	3	3	2	3	3	3	3	3
CLO 4	3	1	3	3	3	3	3	2	3
CLO 5	3	2	3	3	3	3	3	3	3

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Title of the Course		FINANCIAL MATHEMATICS					
Paper Number		ELECTIVE - VI					
Category	Elective	Year	II	Credits	3	Course Code	23KP4MECM6:2
		Semester	IV				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		--	4	
Pre-requisite		Elementary of Stochastic Processes					
Objectives of the Course		• In this course, the students are on posed to the basic concepts of Probability theory, The Central limit theorem. The concepts of Geometric Brownian motion, Option pricing. The derivatives of Blacks chose formula and its applications. • The concept of call option on Dividend paying securities. estimating the volatility parameter. • The limitations of Arbitrage pricing, the portfolio selection problem.					
Course Outline		**UNIT I : Stochastic Order Relations** First-Order Stochastic Dominance -Using Coupling to Show Stochastic Dominance - Likelihood Ratio Ordering -A Single-Period Investment Problem-Second-Order Dominance.					
		UNIT II: Optimization Models Introduction – A Deterministic Optimization Model - Probabilistic Optimization Problems					
		UNIT III: Stochastic Dynamic Programming The Stochastic Dynamic Programming Problem – Infinite Time Models Optimal Stopping Problems					
		UNIT IV: Exotic Options Introduction - Barrier Options - Asian and Look back Options – Monte Carlo Simulation – Pricing Exotic Options by Simulation –More Efficient Simulation Estimators					

Title of the Course		**RESEARCH TOOLS AND TECHNIQUES**					
Paper Number		**SEC III**					
Category	**SEC**	**Year**	II	**Credits**	2	**Course Code**	23KP4MSEC3
		Semester	IV				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	1		--	4	
Pre-requisite		Elementary concepts in sampling and Data Collection.					
Objectives of the Course		To understand the knowledge in sampling test and Research Methods					
Course Outline		**UNIT I:** Research Process – Research Design. **UNIT II:** Research Problem –Variables and Their Types. **UNIT III:** Formulation of Hypothesis – Sampling – Tools of Data Collection. **UNIT IV:** Data Analysis – Interpretation of Data. **UNIT V:** Research Methods –Descriptive or Survey Method Experimental Method					
Extended Professional Component		Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations UPSC/TNPSC/others to be solved (To be discussed during the Tutorial hour)					
Skills acquired from this course		Knowledge,ProblemSolving,Analyticalability,ProfessionalCompetency, 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					

	UNIT V : Beyond Geometric Brownian Motion Models Introduction – Crude Oil Data – Models for the Crude Oil Data –Final Comments.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.An Elementary Introduction to Mathematical Finance, 2nd Edition Sheldon M.Ross Cambridge University press 2005
Reference Books	1. AFirst Course in Probability, S.M.Ross. Engle wood cliffs Prentice HallNJ 2002 2. Option Market, J. Cox M. Rubinstein, Englewood cliffs Prentice Hall NJ, 1985 3. Theory of Financial decision Making, J. E .Ingersill .Lanjarn MD Rower man of LittleFields1987
Website and e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

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VIII. Continuous Internal Assessment System

	Maximum	Components			Passing Minimum
		Attendance	CIA	Seminar / Assignment	
Theory	25	05	15	05	10
Practical*	40	05	15	20 (Record)	16

** Department specific*

IX. Question Pattern

	Part A	Part B	Part C
Semester Exam: Theory (75)	10 x 2=20 (Answer All)	5 x 5= 25 (Internal choice)	3 x10 =30(Open choice)
Semester Exam: Practical (60)	5 x 10 = 50*	---	---
CIA Exam: Theory (50)	5x 2=10 (Answer All)	4 x 5= 20 (Internal choice)	2 x 10 =20(Open choice)
Model Exam Theory (75)	10x 2=20 (Answer All)	5 x 5= 25 (Internal choice)	3 x 10 =30(Open choice)
*Model Exam: Practical (50)	5 x10 = 50	---	---

** Department specific*

X . Question Allocation and Blooms Taxonomy for (Direct) Assessment

Unit	Section & Marks	Question Number	Blooms Level	Action Verbs
I	A (2 mark)	1-2	I / II	*Level I: Choose, Define, Find, How, Label, List, Match, Name, Select, Show, Tell, What, When, Where, Which, Who, Why* *Level II: Classify, Compare, Contrast, Demonstrate, Explain, Extend, Illustrate, Infer, Interpret, Outline, Relate, Show, Summarize, Translate* *Level III: Apply, Build, Choose, Construct, Develop, Experiment with, Identify, Interview, Make use of, Model, Organize, Plan, Select, Solve, Utilize* *Level IV: Analyze, Assume, Categorize, Discover, Dissect, Distinguish, Divide, Examine, Function, Inference, Inspect, Motive, Relationships, Simplify, Survey, Take part in, Test for, Theme* *Level V: Agree, Appraise, Assess, Award, Conclude, Criteria, Criticize, Decide, Deduct, Defend, Determine, Disprove, Estimate, Evaluate, Importance, Influence, Interpret, Judge, Justify, Mark, Measure, Opinion, Perceive, Prioritize, Prove, Rate, Recommend, Rule on, Select, Support, Value* *Level VI: Adapt, Combine, Compile, Compose, Construct, Create, Delete, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Happen, Imagine, Improve, Invent, Make up, Maximize, Minimize, Modify, Original, Originate, Plan, Predict, Propose, Solution, Solve, Suppose, Test, Theory*
	B (5 mark)	11 (a) and (b)	I / II	
	C (10 mark)	16	I / II	
II	A (1 mark)	3-4	I / II	
	B (5 mark)	12 (a) and (b)	I / II	
	C (10 mark)	17	I / II	
III	A (1 mark)	5-6	I / II	
	B (5 mark)	13 (a) and (b)	III / IV	
	C (10 mark)	18	III / IV	
IV	A (1 mark)	7-8	I / II	
	B (5 mark)	14 (a) and (b)	III / IV	
	C (10 mark)	19	V / VI	
V	A (1 mark)	9-10	I / II	
	B (5 mark)	15 (a) and (b)	V / VI	
	C (10 mark)	20	V / VI	

BL	No. Of Questions (Sections)			Total Marks	% of Marks
	A	B	C		
I. Remembering	12	4	2	12	50
II. Understanding	08			48	
III. Applying	-	4	2	20	33
IV. Analyzing	-			20	
V. Evaluating	-	2	1	10	17
VI. Creating	-			10	
Total Questions	20	10	5	120	100

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XI. Teaching Methodology Adopted: (department specific) + Department may adopted at least a 20 % of ICT enabled classes out of total hours of each course work and proper documents *(Date, Hour, Course and unit, name of the faculty and sign of the representative student)* to be maintained for the same

XII. Outline of Learning Outcomes - based Curriculum Frame work (LOCF)
(All the following categories of courses will be given with definition, procedure and system of implementation)

1. CC : Core Course : 12 Theory + 1 Practical + 1 Project **(14)**
2. EC : Elective Courses : 6 Theory
3. ECC - Extra Credit Course
   (A) SS-Self Study : 2
   (B) Add on Course : 1

* Add-on Certificate Courses with 10-30 contact Hrs conducting by Course Coordinator of the Department / College

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QUESTION BLUE PRINT (75 Marks)

Q.No	*Unit*	*Blooms Level*
		Part A
1	I	Remembering I / Understanding II
2	I	Remembering I / Understanding II
3	I	Remembering I / Understanding II
4	I	Remembering I / Understanding II
5	II	Remembering I / Understanding II
6	II	Remembering I / Understanding II
7	II	Remembering I / Understanding II
8	II	Remembering I / Understanding II
9	III	Remembering I / Understanding II
10	III	Remembering I / Understanding II
11	III	Remembering I / Understanding II
12	III	Remembering I / Understanding II
13	IV	Remembering I / Understanding II
14	IV	Remembering I / Understanding II
15	IV	Remembering I / Understanding II
16	IV	Remembering I / Understanding II
17	V	Remembering I / Understanding II
18	V	Remembering I / Understanding II
19	V	Remembering I / Understanding II
20	V	Remembering I / Understanding II
		Part B
21 (a)	I	Remembering I / Understanding II
(b)	I	Remembering I / Understanding II
22 (a)	II	Remembering I / Understanding II
(b)	II	Remembering I / Understanding II
23 (a)	III	Applying III / Analyzing IV
(b)	III	Applying III / Analyzing IV
24 (a)	IV	Applying III / Analyzing IV
(b)	IV	Applying III / Analyzing IV
25 (a)	V	Creating V / Evaluating V I
(b)	V	Creating V / Evaluating V I
		Part C
26	I	Remembering I / Understanding II
27	II	Remembering I / Understanding II
28	III	Applying III / Analyzing IV
29	IV	Applying III / Analyzing IV
30	V	Creating V / Evaluating V I

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