GOVERNMENT ARTS COLLEGE (AUTONOMOUS)
KUMBAKONAM

(Re-accredited with B++ Grade by NAAC & Affiliated to Bharathidasan University)

DEPARTMENT OF MATHEMATICS

M.Sc.,

MATHEMATICS

SYLLABI

FROM THE ACADMIC YEAR

2023-2024

Syllabus Pattern for M.Sc., Mathematics
Under Choice Based Credit System
(For Students Admitted from 2023 onwards)

No.	Subject Code	Core/ Elective	Subject	Hours	Credit	Marks
SEMESTER I						
1	23P1M1	Core I	Algebraic Structures	6	5	100
2	23P1M2	Core II	Real Analysis I	6	5	100
3	23P1M3	Core III	Ordinary Differential Equations	6	4	100
4	23P1M4EC	Elective I	Number Theory/Mathematical Statistics/Formal languages and Automata Theory	6	3	100
5	23P1M5EC	Elective II	Discrete Mathematics / Mathematical Programming / Lie Groups and Lie Algebras/ Fuzzy sets and their Applications	6	3	100
Total				**30**	**20**	**500**
SEMESTER II						
6	23P2M6	Core IV	Advanced Algebra	6	5	100
7	23P2M7	Core V	Real Analysis II	6	5	100
8	23P2M8	Core VI	Partial Differential Equations	6	4	100
9	23P2M9EC1	Elective III	Algebraic Topology /Programming in C++/ Statistical data analysis using R programming	4	3	100
10	23P2M10EC	Elective IV	Mathematical Methods /wavelets/ Modeling and simulation with excel/ Machine learning and AI	4	3	100
11	23P2M11SEC	SEC I	Numerical Analysis using SCI Lab	4	2	100
Total				**30**	**22**	**600**
SEMESTER III						
12	23P3M12	Core VII	Complex Analysis	6	5	100
13	23P3M13	Core VIII	Topology	6	5	100
14	23P3M14	Core IX	Graph Theory and its Applications	6	5	100
15	23P3M15	Core X	Optimization Techniques	5	4	100
16	23P3M16EC	Elective V	Stochastic Processes/ Algebraic Number Theory / Neural networks/Tensor Analysis And Relativity	4	4	100

17	23P3M17SEC	SEC II	Practicals in C++	3	2	100
18		Internship		-	2	-
Total				**30**	**27**	**600**
SEMESTER IV						
19	23P4M18	Core XI	Functional Analysis	6	5	100
20	23P4M19	Core XII	Differential Geometry	6	5	100
21	23P4M20EC	Elective VI	Classical Dynamics/Financial Mathematics / Resource management Techniques/ Algebraic geometry	4	4	100
22	23P4M21SEC	SEC III	Probability and statistics	4	2	100
23	23P4M22PW	Core XIII	Project work	10	7	100
24	23P4MEA		Extension Activity	-	1	-
Total				**30**	**24**	**500**
Grand Total				**120**	**93**	**2200**

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M.Sc., MATHEMATICS

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ALGEBRAIC STRUCTURES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P1M1</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Modern Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only).</td></tr>
<tr><td colspan="6">UNIT-II : Solvable groups - Direct products - Finite abelian groups- Modules.</td></tr>
<tr><td colspan="6">UNIT-III : Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.</td></tr>
<tr><td colspan="6">UNIT-IV : Jordan form - rational canonical form.</td></tr>
<tr><td colspan="6">UNIT-V: Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved

(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	I.N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975. Unit I : Chapter 2: Sections 2.11 and 2.12 Unit II : Chapter 5 :Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only) ; Chapter 4: Section 4.5 Unit III :Chapter 6: Sections 6.4, 6.5 Unit IV:Chapter 6 : Sections 6.6 and 6.7 Unit V :Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)
Reference Books	1. M.Artin, *Algebra,* Prentice Hall of India, 1991. 2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997. 5. N.Jacobson, *Basic Algebra,* Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups.

CLO 2: Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules.

CLO 3: Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nilpotence with invariants.

CLO 4: Define Jordan,canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation.

CLO 5: Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation in Hermitian, unitary and normal

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				
CO2				√			√			
CO3			√					√		
CO4		√							√	
CO5					√					√

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M.Sc., MATHEMATICS

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">REAL ANALYSIS I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P1M2</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td colspan="2"></td><td>4</td><td>1</td><td>--</td><td colspan="3">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level real analysis concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">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.
Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td colspan="6">UNIT-III : The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals.</td></tr>
</table>

	UNIT-IV :Infinite Series and infinite Products - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products. **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem
	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.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. Unit I :Chapter – 6 : Sections 6.1 to 6.8 and Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18 Unit II :Chapter - 7 : Sections 7.1 to 7.14 Unit III :Chapter - 7 : 7.15 to 7.26 Unit IV:Chapter - 8 Sec, 8.20, 8.21 to 8.26 and Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23 Unit V :Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13
Reference Books	1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976. 2. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976. 3. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991. 4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991. 5. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964. 6. A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				
CO2				√			√			
CO3			√					√		
CO4		√							√	
CO5					√					√

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ORDINARY DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23P1M3</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td>--</td><td colspan="3">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Calculus and Differential Equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Linear equations with constant coefficients
Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.</td></tr>
<tr><td colspan="6">UNIT-II : Linear equations with constant coefficients
Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.</td></tr>
<tr><td colspan="6">UNIT-III : Linear equation with variable coefficients
Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.</td></tr>
<tr><td colspan="6">UNIT-IV :Linear equation with regular singular points
Euler equation – Second order equations with regular singular points – Exceptional cases – Bessel Function.</td></tr>
<tr><td colspan="6">UNIT-V : Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	E.A.Coddington, *An introduction to ordinary differential equations* (3^{rd} Printing) Prentice-Hall of India Ltd., New Delhi, 1987. Unit I :Chapter 2: Sections 1 to 6 Unit II :Chapter 2 : Sections 7 to 12. Unit III :Chapter : 3 Sections 1 to 8 (Omit section 9) Unit IV: Chapter : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9) Unit V :Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)
Reference Books	1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, 1967. 2. George F Simmons, *Differential equations with applications and historical notes*, Tata McGraw Hill, New Delhi, 1974. 3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965. 4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971 5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand& Company Ltd. New Delhi 2001 6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations*, Narosa Publishing House, New Delhi, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Establish the qualitative behavior of solutions of systems of differential equations .

CLO2: Recognize the physical phenomena modeled by differential equations and dynamical systems.

CLO3: Analyze solutions using appropriate methods and give examples.

CLO4: Formulate Green's function for boundary value problems.

CLO5: Understand and use various theoretical ideas and results that underlie the mathematics in this course.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				√
CO2				√			√			
CO3	√		√					√		
CO4		√							√	
CO5					√					√

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NUMBER THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23P1M4EC</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level algebra and calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Solve polynomial congruences by help of the Chinese remainder theorem. Identify and analyze different types of divisibility tests, Euler's theorem, Wilson theorem, Mobius inversion formula to formulate and solve various related problems. Decide whether a given number is the sum of two or three squares, a given number is a quadradic residue modulo p. Develop right approach towards research in number theory.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Fundamentals of congruences : Basic properties of congruences – Residue Systems - Riffling. Solving congruences: Linear congruences – The theorems of Fermat and Wilson revisited – The Chinese Remainder theorem – Polynomial Congruences.</td></tr>
<tr><td colspan="6">UNIT-II: Arithmetic functions: Combinatorial study of $\phi(n)$ – Formulae for D(n) and $\sigma(n)$ - Multiplicative Arithmetic functions – The Mobius Inversion formula. Primitive roots: Properties of reduced Residue systems – Primitive roots Modulo P.</td></tr>
<tr><td colspan="6">UNIT III:Quadratic Residues: Euler's criterion – The Legendre symbol – The Quadratic reciprocity law – Applications of Quadratic Reciprocity law. Distributions of Quadratic Residues: Consecutive Residues and nonresidues.</td></tr>
<tr><td colspan="6">UNIT-IV: Sums of squares :Sums of two squares – Sums of Four Squares. Elementary partition theory: Introduction - Graphical representation – Euler's partition theorem – Searching for partition Identities.</td></tr>
<tr><td colspan="6">UNIT-V: Partition generating Functions: Infinite Products as Generating functions – Identities between Infinite series and Products. Partition Identities: History and Introduction – Euler's Pentagonal Number Theorem – The Roger's Ramanujan Identities.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	E. Andrews, Number Theory, Published by Courier Corporation ,1971. Unit I :Chapters 4& 5 Unit II :Chapters 6 & 7. Unit III :Chapters 9 & 10 (omit 10.2) Unit IV: Chapters 11 & 12. Unit V :Chapters 13 & 14(omit 14.4 & 14.5)
Reference Books	1. J.William, Fundamentals of number theory, Leveque, Addison Wesley Publishing company,Philipines,1977. 2. Tom.M.Apostol, Introduction to analytics number theory, Springer Science and business Media,1998.
Website and **e-Learning Source**	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√					√				√
CO2				√			√			
CO3	√		√					√		
CO4		√								
CO5					√					√

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL STATISTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P1M4EC</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week (hrs)</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td>-</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Knowledge in UG Level</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To impart the statistical concepts and results with rigorous Mathematical treatment.

To enable the real-life applications of Statistics</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">Unit I: Sample Moments and their functions- The notion of Sample and statistic-The distribution of arithmetic mean and independent normally distributed random variables- The χ^2 distribution-The distribution of the statistic ($\overline{X}, S$); Student's t- distribution- Fisher's Z-distribution-The distribution of $\overline{X}$ for some non-normal populations.</td></tr>
<tr><td colspan="6">Unit II: The distribution of sample moment and sample and sample correlation coefficients of a two-dimensional normal population-The distribution of regression coefficients- Limit distribution of sample moments. Order Statistics-The notion of an order statistic – the empirical distribution function –Stochastic convergence of sample quantiles.</td></tr>
<tr><td colspan="6">Unit III :Limit distribution of sample quantiles - The limit distribution of successive sample elements- the joint distribution of a group of quantiles – The distribution of the sample range-Tolerance limits- Glivenko Theorem - The theorems of Kolmogorov and Smirnov- Renyi's theorem- the problem of k-samples.</td></tr>
<tr><td colspan="6">Unit IV:An Outline of the Theory of Runs- the notion of a run- the probability distribution of the number of runs - the expected value and the variance of the runs.</td></tr>
</table>

	Unit V: Significance Test- The concepts of a statistical test- parametric test for small samples and large samples- The χ^2 test- Test of the Kolmogorov and Smirnov Type- the wald Wolfovitz and Mann –Whitney test- Independence test by contingency tables.
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 Class hour)
Skills acquired from this course	Knowledge, Problem Solving
Recommended Text	M. Fisz,Probability Theory and Mathematical Statistics, John Wiley and Sons, New york, 1963. Unit I :Section 9.1 – 9.8 Unit II :Section 9.9, 9.10 and 10.1 – 10.4 Unit III :Section 10.5 – 10.13 Unit IV:Section 11.1 -11.4 Unit V :Section 12.1 -12.7
Reference Books	1. Gupta. S.C. &Kapoor,V.K. (2002) . Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi 2. Mood A. M &Graybill F. A &Boes D. G (1974) : Introduction to theory of Statistics, Mcgraw Hill. 3. Hogg R. V. & Craig A. T. 1988) : Introduction to Mathematical Statistics, Mcmillan. Bansilal andArora (1989).New Mathematical Statistics, SatyaPrakashan, New Delhi.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Sample Moments and their functions
CLO 2: Limit distribution of sample moments
CLO 3: Limit distribution of sample quantiles
CLO 4: An Outline of the Theory of Runs
CLO 5: Significance Test.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				
CO2							√			
CO3	√		√							
CO4		√							√	
CO5					√					√

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FORMAL LANGUAGES AND AUTOMATA THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23P1M4EC</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="3"></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>5</td><td colspan="2">1</td><td>--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Discrete Mathematics, e.g., graphs, trees, logic, and proof techniques.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the notion of effective computability by studying Finite Automata, Regular Expressions, Regular Languages and Free Grammars.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I: Why Study Automata Theory? -Introduction to Formal Proof- Additional Forms of Proof-Inductive Proofs.</td></tr>
<tr><td colspan="6">Unit II: An Informal Picture of Finite Automata-Deterministic Finite Automata-Non-Deterministic Finite Automata-An Application: Text Search.</td></tr>
<tr><td colspan="6">Unit III: Regular Expressions-Finite Automata and Regular Expressions-Application of Regular Expressions-Algebraic Laws of Regular Expressions.</td></tr>
<tr><td colspan="6">Unit IV: Proving Languages are Not Regular-Closure Properties of Regular Languages-Decision Properties of Regular Languages-Equivalence and Minimization of Automata.</td></tr>
<tr><td colspan="6">Unit V: Context-Free Grammars-Parse Trees-Application of Context-Free Grammar-Ambiguity in Grammars and Languages.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	J. E. Hopcroft, R. Motwani and J.D. Ullman; Introduction to Automata Theory, Languages, and Computation. Second Edition, Pearson Edition, 2001. Unit I :Chapter 1: Sections 1.1 – 1.4 Unit II :Chapter 2: Sections 2.1 – 2.4 Unit III :Chapter 3: Sections 3.1 – 3.4 Unit IV: Chapter 4: Sections 4.1 – 4.4 Unit V :Chapter 5: Sections 5.1 – 5.4
Reference Books	1. P.K. Srimani and S.F.B. Nasir; A text book on Automata theory, Cambridge University press, 2007. 2. J.P. Tremblay and R. Manohar; Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill Education (India) Pvt Ltd, 2017.
Website and **e-Learning Source**	https://en.wikipedia.org/wiki/Automata_theory, https://en.wikiversity.org/wiki/Automata_theory,

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understand the basic properties of formal languages and grammars.
CLO 2: make grammars to produce strings from a specific language..
CLO 3: design sample Automata
CLO 4: minimize Finite Automata and grammar of context-free languages.
CLO 5: differentiate regular, context-free and recursively enumerate languages.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				√
CO2							√			
CO3	√							√		
CO4		√							√	
CO5										√

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Discrete Mathematics</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23P1M5EC</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="3"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">5</td><td colspan="2">---</td><td>1</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level sets and functions</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the basic idea of semi groups, monoids, Lattices, Boolean Algebra, Grammer and Languages</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I: Mathematical Logic: Statements and Notation - Connectives – Normal Forms – The Theory of Inference for the Statement Calculus.</td></tr>
<tr><td colspan="6">Unit II:Lattices: Lattices as partially ordered sets and their properties, Lattices as algebraic systems, sublattices, Direct products and homomorphisms, Some special lattices such as complete, complemented and distributive lattices.</td></tr>
<tr><td colspan="6">Unit III: Boolean Algebra and Boolean functions: Boolean Algebra as Lattices, Various Boolean identities, The switching algebra example, Sub-algebras, direct product and homomorphisms, join irreducible elements, Atoms and minterms, Boolean forms and their equivalence, Minterms Boolean forms, sum of products, canonical forms, Minimization of Boolean forms, Boolean forms and Free Boolean Algebras, Values of Boolean expressions and Boolean functions.</td></tr>
<tr><td colspan="6">Unit IV:Algebraic Structures: Binary operation, General properties, Algebraic structures, semigroups and monoids, Homomorphism of semigroups and monoids, Groups, Sub-group, Cosets, Cyclic groups, Normal subgroups.</td></tr>
<tr><td colspan="6">Unit V: Grammars and Languages: Finite State Machine, Finite state Homomorphism, Formal language and Grammar, Finite Automata.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.
Recommended Text	G. Shanker Rao, Discrete Mathematical Structures, 2nd Edition, New Age International Publishers. Unit I :Chapter 1: 1.1-1.22 Unit II :Chapter 5: 5.16 to 5.20 Unit III :Chapter 5: 5.21 to 5.27 Unit IV: Chapter 9: 9.1 to 9.11, 9.20, 9.22, 9.26, 9.27. Unit V :Chapter 10: 10.4 to 10.11
Reference Books	1 J.P Trumbly and R. Monohar , Discrete Mathematical Structure and its application to computer Science, Tata McGraw Hills, New Delhi 2 Kenneth H Rosan, Discrete Mathematics and its applications, 7th edition, WCB/McGraw Hill Educations, New York 2008
Website and **e-Learning Source**	-

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Semigroups and Monoids
CLO 2: Lattices
CLO 3: Grammars and Languages
CLO 4: Boolean Algebra
CLO 5: Boolean functions.

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				√
CO2				√			√			
CO3	√							√		
CO4		√								
CO5					√					√

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P1M5EC</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">---</td><td>1</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Operations Research</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the methods of optimization techniques, the theory of optimization techniques and familiar in solving techniques, analysing the results and propose recommendations to the decision making process.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">Unit I:Integer Linear Programming: Introduction - Illustrative application integer programming solution algorithms, Branch and Bound Algorithm –zero-one implicit enumeration algorithm- Cutting plane algorithm</td></tr>
<tr><td colspan="6">Unit II: Deterministic Dynamic Programming: Introduction- Recursive nature of computation in DP- Forward and Backward recursion- Selected DP applications cargo- Loading model- - Work force size model- Equipment – replacement model- Inventory models</td></tr>
<tr><td colspan="6">Unit III: Decision Analysis and Games:Decision environment- Decision making under certainty (Analytical Hierarchy approach). Decision making under risk- Expected value criterion- Variations of the expected value criterion – Decision under uncertainty Game theory. Optimal solution of Two – Person zero-Sum games- Solution of mixed strategy games</td></tr>
<tr><td colspan="6">Unit IV:Simulation Modeling :What is simulation? Monte Carlo Simulation- Types of simulation- Elements of Discrete Event simulation- Generic definition of events- Sampling from probability distributions. Methods for gathering statistical observations – Sub Interval method- Republican method- Regenerate (Cycle Method)- Simulation Languages</td></tr>
</table>

	Unit V: Nonlinear Programming Algorithm: Unconstrained nonlinear Programming algorithm- Direct search method- Gradient method Constrained algorithms: Separable programming- Quadratic programming- Geometric programming- Stochastic programming- Linear Combination Method- SUMT algorithm
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	Hamdy A.Taha, Operation Research an Introduction, 6th edition, University of Arkansas Fayetteville. Unit I :Chapter 9: 9.1, 9.2.1, 9.2.3 Unit II :Chapter10:10.1 to 10.3 Unit III :Chapter 14: 14.1 to 14.4 Unit IV: Chapter 18: 18.1 to 18.7 Unit V :Chapter 21: 21.1, 21.2
Reference Books	1.F.S. Hillier and G. J. Liberman Introduction to operation Research 4th Edition, Mc Gno Hill Book Compnany, New York, 1989 2.B.E.Gillett, Operation Research- A computer oriented algorithmic Approach, TMH Edition NewDelhi, 1976
Website and **e-Learning Source**	www.pearsonglobaleditions.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Integer Linear Programming
CLO 2: Deterministic dynamic Programming
CLO 3: Decision analysis and games
CLO 4: Simulation Modeling
CLO 5: Nonlinear Programming algorithm

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				√
CO2							√			
CO3	√		√					√		
CO4		√								
CO5					√					√

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">LIE GROUPS AND LIE ALGEBRAS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P1M5EC</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">---</td><td>1</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basics set theory and Groups</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the concept of Lie Algebras and Lie Groups and to study their properties</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I:Lie groups, Subgroups, and cosets, Action of Lie groups on manifolds and representations, Orbits and homogeneous spaces, Left, right, and adjoint action, Classical groups.</td></tr>
<tr><td colspan="6">Unit II:Exponential map, The commutator, Adjoint action and Jacobi identity.</td></tr>
<tr><td colspan="6">Unit III:Subalgebras, ideals, and centre, Lie algebra of vector fields, Stabilizers and the center.</td></tr>
<tr><td colspan="6">Unit IV:Campbell-Hausdorff formula, Fundamental theorems of Lie theory, Complex and real forms, Example: $\boldsymbol{so}(3, \mathbb{R})$, $\boldsymbol{su}(2)$, and $\boldsymbol{sl}(2, \mathbb{C})$</td></tr>
<tr><td colspan="6">Unit V:Basic definitions, Operations on representations, Irreducible representations, Intertwining operators and Schur lemma.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved

(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.</td></tr>
</table>

Recommended Text	Introduction to Lie Algebras and Lie Groups Unit I :Chapter 2: 2.1-2.5 Unit II :Chapter 3: 3.1-3.3 Unit III :Chapter 3: 3.4-3.6 Unit IV:Chapter 3: 3.7-3.10 Unit V :Chapter4 : 4.1-4.4
Reference Books	1. Lie Groups , Lie Algebras, and Representations. 2. Introduction to Lie Algebras and representation theory. 3. Introduction to Lie Algebras
Website and **e-Learning Source**	www.math.sunysb.edu/"kirillov

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understandthe definition of Lie Groups and Lie Algebras.

CLO 2: studied exponential map, The commutator, Adjoint action and Jacobi identity.

CLO 3: gained the Subalgebras, ideals, and centre, Lie algebra of vector fields, Stabilizers and the center.

CLO 4: Campbell-Hausdorff formula, Fundamental theorems of Lie theory, Complex and real forms, Example: ***so***(3, ℝ), ***su***(2), and ***sl***(2, ℂ)

CLO 5: Operations on representations, Irreducible representations, Intertwining operators and Schur lemma.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2				√			√			
CO3	√		√					√		
CO4		√				√			√	
CO5					√					√

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SEMESTER - I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FUZZY SETS AND THEIR APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P1M5EC</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">---</td><td>1</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level sets and functions</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the concept of uncertainty and fuzziness in logic and to study fuzzy arithmetic, fuzzy relations and construction of fuzzy sets</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I:Crisp sets and fuzzy sets: Introduction – Crisp Sets: An Overview – Fuzzy Sets: Basic Types – Fuzzy Sets: Basic Concepts.</td></tr>
<tr><td colspan="6">Unit II: Fuzzy sets versus crisp sets: Additional Properties of a-cuts Representations of Fuzzy Sets – Extension Principle for Fuzzy Sets.</td></tr>
<tr><td colspan="6">Unit III: Operations on fuzzy sets: Types of operations – Fuzzy Complements.</td></tr>
<tr><td colspan="6">Unit IV:Fuzzy Intersections: t-Norms – Fuzzy Unions: t-conorms.</td></tr>
<tr><td colspan="6">Unit V: Fuzzy Arithmetic: Fuzzy Numbers – Linguistic Variables – Arithmetic Operations on Intervals – Arithmetic Operations on Fuzzy Numbers.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.</td></tr>
</table>

Recommended Text	Georgr J. Klir and Bo Tuan, Fuzzy Sets and Fuzzy Logic Theory and applications, PHI Leaning private Limited, New delhi, 2004 Unit I: Chapter 1: 1.1 to 1.4 Unit II: Chapter 2: x2.1 to 2.3 Unit III: Chapter 3: 3.1 to 3.2 Unit IV: Chapter 3: 3.3 to 3.4 Unit V Chapter 4: 4.1 & 4.4
Reference Books	1. A.K. Bhargava: Fuzzy Set Theory, Fuzzy Logic and their Applications, published by S. Chand Pvt limited, 2013 2. S. Rajasekaran& Y.A. VijiaylakshmiPai, Neural Networks, Fuzzy logic and genetic algorithms, Prentice Hall of India
Website and e-Learning Source	-

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Crisp sets and fuzzy sets

CLO 2: Operation on Fuzzy sets

CLO 3: Fuzzy relation

CLO 4: Decision making in Fuzzy environment

CLO 5: Applications

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2							√			
CO3	√		√					√		
CO4						√			√	
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ADVANCED ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P2M6</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Algebraic Structures</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I :Extension fields – Transcendence of e.</td></tr>
<tr><td colspan="6">UNIT-II : Roots or Polynomials.- More about roots</td></tr>
<tr><td colspan="6">UNIT-III : Elements of Galois theory.</td></tr>
<tr><td colspan="6">UNIT-IV : Finite fields - Wedderburn's theorem on finite division rings.</td></tr>
<tr><td colspan="6">UNIT-V :Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">I.N. Herstein. Topics in Algebra (II Edition) Wiley EasternLimited, New Delhi, 1975.
Unit I: Chapter 5: Section 5.1 and 5.2
Unit II: Chapter 5: Sections 5.3 and 5.5
Unit III: Chapter 5 : Section 5.6
Unit IV: Chapter 7: Sections 7.1 and 7.2
Unit V :Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1); Chapter 7 : Sections 7.3 and 7.4</td></tr>
</table>

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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Prove theorems applying algebraic ways of thinking.

CLO2: Connect groups with graphs and understanding about Hamiltonian graphs.

CLO3: Compose clear and accurate proofs using the concepts of Galois Theory.

CLO4: Bring out insight into Abstract Algebra with focus on axiomatic theories.

CLO5: Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2				√			√			
CO3	√		√					√		
CO4		√				√			√	
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">REAL ANALYSIS II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P2M7</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td colspan="2"></td><td>5</td><td>1</td><td>--</td><td colspan="3">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT-I :Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability</td></tr>
<tr><td colspan="6">UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals</td></tr>
<tr><td colspan="6">UNIT-III : Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point – Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem</td></tr>
<tr><td colspan="6">UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1</td></tr>
</table>

	UNIT-V : Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II) 2. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V) Unit I: Chapter - 2 Sec 2.1 to 2.5 (de Barra) Unit II: Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra) Unit III: Chapter 11 : Sections 11.1 to 11.15 (Apostol) Unit IV: Chapter 12 : Section 12.1 to 12.14 (Apostol) Unit V :Chapter 13 : Sections 13.1 to 13.7 (Apostol)
Reference Books	1. Burkill,J.C.*The Lebesgue Integral*, Cambridge University Press, 1951. 2. Munroe,M.E.*Measure and Integration*. Addison-Wesley, Mass.1971. 3. Roydon,H.L.*Real Analysis*, Macmillan Pub. Company, New York, 1988. 4. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979. 5. Malik,S.C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Limited. New Delhi, 1991. 6. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2							√			
CO3	√		√					√		
CO4		√				√				
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PARTIAL DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23P2M8</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>5</td><td>1</td><td>--</td><td colspan="3">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level partial differential equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I :Mathematical Models and Classification of second order equation : Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution</td></tr>
<tr><td colspan="6">UNIT-II :Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.</td></tr>
<tr><td colspan="6">UNIT-III :Method of separation of variables: Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations</td></tr>
<tr><td colspan="6">UNIT-IV : Boundary Value Problems : Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.</td></tr>
<tr><td colspan="6">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.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	TynMyint-U and Lokenath Debnath, Linear*Partial Differential Equations for Scientists and Engineers* (Fourth Edition), North Hollan, New York, 1987. Unit I: Chapter 3 : Sections 3.1 to 3.6 &Chapter 4 : Sections 4.1 to 4.4 Unit II :Chapter 5: Sections 5.1 to 5.11 Unit III: Chapter 7 : Sections 7.1 to 7.7 Unit IV: Chapter 9 : Sections 9.1 to 9.9 Unit V: Chapter 11 : Section 11.1 to 11.9
Reference Books	1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964. 2. I.N.Sneddon, *Elements of Partial Differential Equations*, McGraw Hill, New Delhi, 1983. 3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, New York, 1968. 4. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand& Company Ltd., New Delhi, 2001. 5. S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2							√			
CO3	√		√					√		
CO4		√				√			√	
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ALGEBRAIC TOPOLOGY</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 rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P2M9EC1</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week (hrs)</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">1</td><td>-</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Fundamentals of group theory and Topology</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Learn how basic geometric structures may be studied by transforming them into algebraic questions.
• Learn basics of homology theory and apply it to get a generalization of Eulers formula to a general polyhedral.
• Learn to associate various groups namely homology groups of various dimensions and the homotopy group- the fundamental group to every topological space.
• Learn that two objects that can be deformed into one another will have the same homology group.
• Learn Brouwer fixed point theorem and related results.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">Unit I: Geometric Complexes and Polyhedra: Introduction. Examples, Geometric Complexes and Poly- hedra, Orientation of geometric complexes;</td></tr>
<tr><td colspan="6">Unit II:Simplicial Homology Groups: Chains, cycles, Boundaries and homology groups, Examples of homology groups, The structure of homology groups- Simplicial Homology Groups(Contd.): The Euler Poincare's Theorem, Pseudomanifolds and the homology groups of S n ;</td></tr>
<tr><td colspan="6">Unit III: Simplicial Approximation: Introduction, Simplicial approximation, Induced homomorphisms on the Homology groups, The Brouwer fixed point theorem and related results</td></tr>
<tr><td colspan="6">Unit IV: The Fundamental Group: Introduction, Homotopic Paths and the Fundamental Group, The Covering Homotopy Property for S 1 , Examples of Fundamental Groups</td></tr>
</table>

	Unit V: Covering spaces- The definitions and some examples- Properties of covering spaces – Classification of covering space- universal covering space.
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 Class hour)
Skills acquired from this course	Knowledge, Problem Solving
Recommended Text	Fred h. Croom, Basic Concepts of Algebraic Topology, utm, springer - verlag, ny, 1978. Unit I: Chapter 1: Sections 1.1 to 1.4 Unit II :Chapter 2: Sections 2.1 to 2.5 Unit III :Chapter 3: Sections 3.1 to 3.4 Unit IV: Chapter 4: Sections 4.1 to 4.4 Unit V >Chapter 5: Sections 5.1 to 5.4
Reference Books	1. Eilenberg S, Steenrod N.: Foundations of Algebraic Topology; Princeton Univ. Press; 1952 2. S.T. Hu: Homology Theory; Holden-Day; 1965 3. Massey W.S.: Algebraic Topology : An Introduction; Springer Verlag NY; 1977 4. C.T.C. Wall: A Geometric Introduction to Topology; Addison-Wesley Pub. Co. Reading Mass;1972

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Geometric Complexes and Polyhedra
CLO 2: Simplicial Homology Groups
CLO 3: Simplicial Approximation
CLO 4: The Fundamental Group
CLO 5: Covering spaces

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				
CO2							√			
CO3	√		√					√		
CO4		√				√				
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROGRAMMING IN C++</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>23P2M9EC1</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">3</td><td colspan="2">1</td><td>--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Calculus and Differential Equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To enable the students to
1. Introduce the programming style that is associated with the concepts of class, objects and other concepts resolving around these two, like inheritance and polymorphism.
2. Understand the concept of constructors and distructors.
3. Explain the concepts of operators overloading, type casting operators, type conversions, pointers; pointers to desire object and classes, virtual functions and get complete programming knowledge.
4. Learn the concepts of structures and classes, static members with functions and array of objects.
5. Evolve from procedure oriented programmings to object oriented programming.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT I:Principles of Object-Oriented Programming:Object-Oriented Programming Paradigm - Basic Concepts of Object-Oriented Programming. Beginning with C++:Applications of C++ - Structure of C++ Program. Tokens, Expressions and Control Structures: Identifiers and Constants – Declaration of Variables.</td></tr>
<tr><td colspan="6">UNIT II:Functions in C++: Function prototyping – Default Arguments – Recursion - Function Overloading – Friend and Virtual Functions – Math Library Functions.</td></tr>
<tr><td colspan="6">UNIT III:Classes and Objects: Defining Member Functions – Nesting of Member Functions – Friendly Functions – Local Classes.Constructors and Destructors:Constructors –Constructors with Default Arguments – Constructing Two-Dimensional Arrays – Destructors.</td></tr>
</table>

	UNIT IV: Operator Overloading and Type Conversions: Defining Operator Overloading –Overloading Binary Operators – Manipulation of Strings Using Operators – Rules for Overloading Operators – Type Conversions.
	UNIT V: Inheritance: Extending Classes: Defining Derived Classes – Multiple Inheritance – Abstract Classes – Constructors in Derived Classes.Pointers, Virtual Functions and Polymorphism:Pointers – Pointers to Objects – Pointers to Derives Classes - Virtual Functions – Virtual Constructors and Destructors.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	
Recommended Text	E Balagurusamy., Object-Oriented Programming with C++, McGraw Hill Education (India) Private Limited, Eighth Edition, 2023. Unit I: Chapters 1: 1.4 & 1.5. Chapter 2: 2.2 & 2.6 Chapter 3: 3.4 &3.11 Unit II:Chapter 4: 4.3, 4.7, 4.9, 4.10, 4.11 & 4.12 Unit III:Chapters 5: 5.4, 5.5, 5.15, 5.19 &Chapters 6: 6.2, 6.5, 6.9 & 6.11 Unit IV: Chapter 7: 7.2, 7.4, 7.6, 7.8 & 7.9 Unit V: Chapters 8: 8.2, 8.6 & 8.11 Chapter 9: 9.2, 9.3, 9.6, 9.7 & 9.9
Reference Books	1. Robert Lafore , Turbo C++, Galgotia Publications, 2007. 2. Stephen Prata,C++ Primer plus, Sixth edition, Addison Wesley Professional, 2011.
Website and e-Learning Source	

Course Learning Outcome (for Mapping with POs and PSOs)

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

CLO1: Understand the object oriented programs, which contain both data and functions that act on that data and a class is a template for a number of objects.

CLO2: Learn programming basics, viz., simple functions, call by value and reference, returning values of different type, function overloading, and recursive functions.

CLO3: Apply the programming concepts of c++ for solving mathematical problems.

CLO4: Realize object oriented programmings as a vast improvement over procedural programs.

CLO5: Developesoftwares for solving mathematical problems .

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√				√	√				√
CO2				√			√			
CO3	√		√					√		
CO4		√				√			√	
CO5					√					

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">STATISTICAL DATA ANALYSIS USING R-PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P2M9EC1</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week (hrs)</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">1</td><td>-</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic knowledge in Statistics and Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">After successful completion of the course students should be able to (i) understand the basics in R programming.(ii) Import, review, manipulate and summarize datasets in R.(iii) Explore datasets to create testable hypotheses and identify appropriate statistical tests.(iv) Perform appropriate statistical tests using R. (v) Create and edit visualizations with R.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I: Getting Started - Installing R- Running R -The Comprehensive R Archive Network - Manuals- Contributed documentatio -Getting help in R -Worked examples of functions- Demonstrations of R functions- Packages in R - Contents of packages - Installing packages - Command line versus scripts- Data editor- Changing the look of the R screen - Good housekeeping - Linking to other computer languages.

Unit II: Essentials of the R Language - Calculations - Complex numbers in R - Rounding - Arithmetic -Modulo and integer quotients --Variable names and assignment - Operators - Integers – Factors. Writing R functions- Arithmetic mean of a single sample - Median of a single sample - Geometric mean - Harmonic mean - Variance - Degrees of freedom - Variance ratio test .

Unit III: Graphics.Plots with two variables - Plotting with two continuous explanatory variables: Scatterplots - Adding other shapes to a plot- Drawing mathematical functions - Shape and size of the graphics window - Plotting with a categorical explanatory variable - Plots for single samples - Plots with multiple variables- Special plots.</td></tr>
</table>

	Unit IV: Probability functions - Continuous probability distributions - Normal distribution - The central limit theorem - Maximum likelihood with the normal distribution - Generating random numbers with exact mean and standard deviation - Comparing data with a normal distribution - Other distributions used in hypothesis testing - The chi-squared distribution - Fisher's F distribution -Student's t distribution - The gamma distribution - The exponential distribution -The beta distribution - The Cauchy distribution - The lognormal distribution - The logistic distribution - The log-logistic distribution - The Weibull distribution - Multivariate normal distribution -The uniform distribution - Plotting empirical cumulative distribution functions
	Unit V: Discrete probability distributions - The Bernoulli distribution - The binomial distribution - The geometric distribution - The hyper geometric distribution - The multinomial distribution - The Poisson distribution - The negative binomial distribution - The Wilcoxon rank-sum statistic- Analysis of Variance- ANOVA (one-way)
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 Class hour)
Skills acquired from this course	Knowledge, Problem Solving
Recommended Text	Michael J. CrawleyImperial College London at Silwood Park, UK A John Wiley & Sons, Ltd., PublicationThis edition first published 2013. Unit I :Section 1.1 – 1.11 Unit II : Section 2.1 and 2.15 (2.15 .1 – 2.15.7) Unit III :Section 5.1- 5.11 Unit IV: Section 7.3 Unit V: Section 7.4 and Section 11

Reference Books	1. Sudha G. Purohit et.al., Statistics Using R, Narosa Publishing House, , India(2008) 2. John Verzani, simple R-Using R for Introductory Statistics, (http://www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple.) 3. W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R , Notes on R: A Programming Environment for Data Analysis and Graphics, Version 2.15.2 (2012-10-26) (http://www.r-project.org) 4. D. E. Knuth: The TEX Book. Addison-Wesley, Reading, second edition, 1986.
Online reference	http://www.bio.ic.ac.uk/research/mjcraw/therbook/index.htm

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to
CLO 1: The Comprehensive R Archive Network
CLO 2: Essentials of the R Language
CLO 3: Graphics,Plots with two variables
CLO 4: Probability functions
CLO 5: Discrete probability distributions

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2							√			
CO3	√		√							
CO4		√				√			√	
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL METHODS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23P2M10EC</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="3"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">3</td><td colspan="2">1</td><td>--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Calculus and Differential Equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To enable the students to
1. Acquire knowledge and develop interest in Applied Mathematics.
2. Know about Calculus of Variations.
3. Understand various methods involved in Fourier Transforms.
4. Solve integral and differential equations of Green's Functions.
5. Understand Hilbert Schmidt theory.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I:Variations Problems : Maxima and Minima – The simplest case – Illustrative examples – Natural boundary conditions and transition conditions – The variational notation.</td></tr>
<tr><td colspan="6">UNIT II:Green's Function : Introduction – Relations between differential and integral equations – The Green's function – Fredholm equations with separable kernels – Illustrative example.</td></tr>
<tr><td colspan="6">UNIT III:Hilbert Schmidt Theory :Hilbert-Schmidt Theory – Iterative methods for solving equations of the second kind – The Neumann series – Fredholm theory – Singular Integral equations – Special devices.</td></tr>
<tr><td colspan="6">UNIT IV:Fourier Transforms :Inversion formula for complex Fourier transform – Fourie Cosine and Sine Transforms–linearity property – Change of scale property – Shifting property – modulation and Convolution theorems – problems.</td></tr>
<tr><td colspan="6">UNIT V: Applications Of Fourier Transform In Initial And Boundary Value Problems : Application of infinite Fourier transforms Choice of infinite sine or cosine transforms – Application of finite Fourier transforms – Finite Fourier transform of partial derivatives – Choice of finite sine or cosine transforms.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.Francis B. Hildebrand, Methods Of Applied Mathematics, Second Edition, Courier Corporation , 2012. 2. A.R. Vasista And R . K. Gupta , Integral Transforms, Krishna Prakashan Mandir Ltd, Krishna Educational Publishers, 2014. Unit I: Chapter 2 : 2.1 to 2.5 (Text book I) Unit II: Chapter 3 : 3.1 to 3.3 & 3.6 to 3.7 (Text book I) Unit III: Chapter 3 : 3.8 to 3.13 (Text book I) Unit IV: Chapter 6 :(All sections) (Text book II) Unit V: Chapter 8 :(All sections) (Text book II)
Reference Books	Dr. J.K. Goyal And K.P. Gupta , Integral Transforms, Pragati Prakashan, Meerut ,2013
Website and **e-Learning Source**	

Course Learning Outcome (for Mapping with POs and PSOs)

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

CLO1: Understand different types of methods for solving given differential equations.

CLO2: Know different integral equations and methods of solving them

CLO3: Analyze variational problems with moving boundaries.

CLO4: Understand the theory and applications of Fourier transforms and the properties of various kinds of integral equations.

CLO5: Understand the applications of Fourier transform for initial and boundary value problems.

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2				√			√			
CO3	√		√							
CO4						√				
CO5										√

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M.Sc., MATHEMATICS

(Effective for those admitted from 2023-2024 onwards)

SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">WAVELETS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P2M10EC</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic knowledge knowledge in series and function.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the Wavelet transform, Scaling functions and Wavelet Series in L_p Spaces.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I: Introduction to Wavelets, Motivation and Heuristics, Wavelet Transform, Haar Functions and Haar Series, Haar Sums and Dyadic Projections, Haar Series in C_0 and L_p Spaces, Pointwise Convergence of Haar Series.</td></tr>
<tr><td colspan="6">Unit II: Multiresolution Analysis, Orthonormal Systems and Riesz Systems, Scaling Equations and Structure Constants, From Scaling Function to MRA, Meyer Wavelets.</td></tr>
<tr><td colspan="6">Unit III: 3 From Scaling Function to Orthonormal Wavelet, Direct Proof that $V_1 \ominus V_0$ is spanned by $\{\psi(t-k)\}_{k\in\mathbb{Z}}$, Null Integrability of Wavelets without Scaling Functions.</td></tr>
<tr><td colspan="6">Unit IV: Wavelets with Compact Support, From Scaling Filter to Scaling Function, Explicit Construction of Compact Wavelets, Smoothness of Wavelets, Cohen's Extension Theorem.</td></tr>
<tr><td colspan="6">Unit V: Convergence Properties of Wavelets Expansions, Wavelet Series in L_p Spaces, Jackson's and Bernstein's Approximation Theorems.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations 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	Mark A. Pinsky: Introduction to Fourier Analysis and Wavelets, Cenage Learning India Pvt. Ltd, 2009. Unit I :Chapter 6 - 6.1, 6.2, 6.3 - 6.3.1 to 6.3.3 Unit II :Chapter 6 - 6.4.1 to 6.4.3 Unit III :Chapter 6 - 6.4.5 Unit IV: Chapter 6 - 6.5. Unit V: Chapter 6 - 6.6
Reference Books	1. C. Sidney Burrus, Ramesh A. Gopinath, Haitao Guo: Introduction to Wavelets and Wavelet Transforms, Prentice Hall Upper Saddle River, New Jersey 07458. 2. Jonas Gomes Luiz Velho: From Fourier Analysis to Wavelets, Springer, 2015. 3. M.V. Altaisky: Wavelets Theory, Applications Implementation, University Press, 2009. 4. K.P. Soman, K.I. Ramachandran, N.G. Resmi: Insight into Waveletes from Theory to Practice, Third Edition.
Website and e-Learning Source	-

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand Wavelets and to make use of the tools of Fourier Analysis.

CLO 2: Characterize the smoothness of functions using wavelets.

CLO 3: Understand Haar Wavelet Exapansions and to construct general wavelets.

CLO 4: Develop a systematic method to produce orthonormal wavelets.

CLO 5: Understand scaling functions along with convergence properties and speed of convergence.

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1				√	√	√				√
CO2				√						
CO3	√		√					√		
CO4		√				√			√	
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MODELLING AND SIMULATION WITH EXCEL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23P2M10EC</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">Pre-requisite</td><td colspan="6">Basic Skills in computers</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand modelling and simulation with the help of Excel.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I: Modelling and Simulation: Introduction Model, Classifications of Models, An Example of Deterministic Modelling, A Preliminary Analysis of the Event, Understanding the Important Elements of a Model, Pre-Modelling or Design Phase, Modelling Phase.

Unit II: Resolution of Weather and Related Attendance, Attendees Play Games of Chance, OLPS Modelling Effort, Model Building with Excel, Basic Model, Sensitivity Analysis, Controls from the Forms Control Tools, Option Buttons, Scroll Bars.

UnitIII:Types of Simulation and Uncertainty, Incorporating Uncertain Processes in Models, The Monte Carlo Sampling Methodology, Implementing Monte Carlo Simulation Methods.

Unit IV:Modelling Arrivals with the Poisson Distribution, VLOOKUP and HLOOKUP Functions, A Financial Example– Income Statement, An Operations Example–Autohaus, Status of Autohaus Model.

Unit V: Building the Brain Worksheet, Building the Calculation Worksheet, Variation in Approaches to Poisson Arrivals: Consideration of Modelling Accuracy, Sufficient Sample Size, Building the Data Collection Worksheet, Results.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Ability to create and write new models.
Recommended Text	Hector Guerrero, Excel Data Analysis Modelling and Simulation, Second Edition, Springer.
Reference Books	1. **Cliff T. Ragsdale**, Spreadsheet Modelling and Decision Analysis, Ninth Edition. 2. **John** A. **Sokolowski**, Catherine M. Banks, Modelling and Simulation Fundamentals, A John Wiley & Sons, Inc. Publication, 2010.
Website and e-Learning Source	-

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand a model's structure, its capabilities, and its underlying assumptions.
CLO 2: Deal models in various forms and to understand the visual models of the behavior of a system.
CLO 3: Perform data analysis on both quantitative and qualitative data leading to models of general and specific behavior.
CLO 4: Understand the critical role of Excel in the early or rapid prototyping of problems
CLO 5: Construct a useful and thoroughly conceived simulation model

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2				√			√			
CO3	√		√							
CO4						√			√	
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MACHINE LEARNING AND AI</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P2M10EC</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Skills in machines.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To get artificial intelligence with the help of machines.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I:AI Foundations, Alan Turing and the Turing Test, Strong AI, Weak AI, Golden Age of AI, Technological Drivers of Modern AI, Structure of AI.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit II: Data - The Fuel for AI, Data Basics, Types of Data, Big Data, Volume, Variety and Velocity of Data, Databases and Other Tools, Data Process, Business Understanding, Data Understanding, Data Preparation, Ethics and Governance, How Much Data Do You Need for AI?, More Data Terms and Concepts.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit III: Machine Learning - Mining Insights from Data, What Can You Do with Machine Learning?, The Machine Learning Process - Data Order, Choose a Model, Train the Model, Evaluate the Model, Fine-Tune the Model, Applying Algorithms, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Semi-supervised Learning.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit IV: Common Types of Machine Learning Algorithms, General Framework for Machine Learning Algorithms, Naïve Bayes Classifier, K-Nearest Neighbour, Linear Regression, Decision Tree, Ensemble Modelling, K-Means Clustering.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit V: Deep Learning - Difference Between Deep Learning and Machine Learning, What is Deep Learning, The Brain and Deep Learning, Artificial Neural Networks, Back Propagation, The Various Neural Networks - RNN, CNN, GANs, Deep Learning Applications.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Getting knowledge in artificial intelligence using Machines.
Recommended Text	Tom Taulli, Artificial Intelligence Basics: A Non-Technical Introduction, Apress.
Reference Books	1. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson Education, 2007. 2. Kevin Night, Elaine Rich, and Nair B., Artificial Intelligence, McGraw Hill, 2008. 3. Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition,1997. 4. Charu C. Aggarwal, Data Classification Algorithms and Applications, CRC Press, 2014.
Website and e-Learning Source	-

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand the AI Foundations.

CLO 2: Deal with Data.

CLO 3: Work with Data in an AI project.

CLO 4: Construct Machine Learning Algorithms.

CLO 5: Understand Deep learning.

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				√
CO2							√			
CO3	√		√							
CO4		√				√			√	
CO5					√					√

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SEMESTER - II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Numerical Analysis Practical Using SCI Lab</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SKILL</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23P2M11SEC</td></tr>
<tr><td>Semester</td><td>II</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>--</td><td colspan="2">--</td><td>4</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic skills in Computer.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To give practical knowledge about MATLAB programming using SCILAB.
To teach MATLAB command window and script files and how to use them in programming.
To teach MATLAB Programming to get the solution of Numerical problems.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">1. Newton Raphson method
2. Regula Falsi method
3. Bisection method
4. Gauss Elimination method
5. Gauss Seidel method
6. Trapezoidal method
7. Simpson's 1/3 rule
8. Simpson's 3/8 rule
9. Matrix addition
10. Matrix Multiplication
11. Lagrange interpolation
12. Euler's method
13. Runge Kutta method</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Getting knowledge in artificial intelligence using Networks.
Recommended Text	**Textbook:** 1. ***"MATLAB An Introduction with Application"*** *by Amos Gilat, John Wiley & Sons, Singapore, 2011.*
Reference Books	1. ***"Introduction ToMatlab For Engineering Students",*** *David Houcque Northwestern University, (version 1.2, August 2005)* 2. ***"Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers"*** *by R. Pratap, Oxford University Press, New Delhi, 2010.* 3. ***"Introduction to MATLAB® for Engineers",*** *William J. Palm III, University of Rhode Island, Mc Graw Hill, Third Edition, 2011.*
Website and e-Learning Source	1. https://nptel.ac.in/courses/122106033 2. https://www.youtube.com/watch?v=83S48Fs9WhY 3. https://archive.nptel.ac.in/courses/103/106/103106118/ 4. https://www.youtube.com/watch?v=qpZUQTjFk6Q

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understanding the MATLAB programming and apply to numerical integration problems.

CLO 2: Apply the knowledge of mathematical software MATLAB to solve real world problems efficiently.

CLO 3: Evaluate the Trigonometry problem and also analyze the control structure case problems.

CLO 4: Create the matrix operation problems and Apply the inverse method problems.

CLO 5: Extend their knowledge to pursue research using MATLAB

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√				√	√				√
CO2				√						
CO3	√							√		
CO4		√				√			√	
CO5					√					√

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SEMESTER III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">COMPLEX ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M12</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td>--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Complex Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy’s theorem and evaluation of definite integral and harmonic functions</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT I :Analytic functions as mappings : Conformality: Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area; Linear Transformations: The Linear Group – The Cross Ratio – Symmetry.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT II :Complex integration: Fundamental Theorems: Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy’s Theorem for a Rectangle – Cauchy’s Theorem in a Disk - Cauchy’s Integral Formula: The Index of a Point with Respect to a Closed Curve – The Integral Formula – Higher Derivatives.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT III: Local Properties of Analytic Functions: Removable Singularities – Taylor’s Theorem – Zeros and Poles – The Local Mapping – The Maximum Principle.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT IV :The General Form of Cauchy’s Theorem: Chains and Cycles – Simple Connectivity –Homology – The General Statement of Cauchy’s Theorem – Proof of Cauchy’s Theorem– Locally Exact Differentials – Multiply Connected Regions; The Calculus of Residues: The Residue Theorem– The Argument Principle – Evaluation of Definite Integrals.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT V :Harmonic Functions: Definition and Basic Properties – The Mean- value Property –Poisson’s Formula – Schwarz’s Theorem – The Reflection Principle; Power series Expansions: Weierstrass’s Theorem – The Taylor Series – The Laurent Series.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co., New York, 1979
Unit I :Chapter 3: Sec 2 and Sec 3:3.1-3.3
Unit II :Chapter4: Sec 1 and 2
Unit III : Chapter 4: Sec 3
Unit IV :Chapter 4: Sec 4 and 5
Unit V :Chapter 4: Sec 6 and Chapter 5: Sec 1</td></tr>
</table>

Reference Books	1. Serge Lang, Complex Analysis, Addison Wesley, 1977. 2. S.Ponnusamy,Foundations of Complex Analysis, Narosa Publishing House, NewDelhi, 1997. 3. Karunakaran, Complex Analysis, Alpha Science international Ltd, Second edition, 2005 4. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990. 5. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978 6. E. Hille, *Analytic function Thorey*(2 vols.), Gonm& Co, 1959. **7.** M.Heins, *Complex function Theory*, Academic Press, New York,1968.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to
CLO1: Analyze and evaluate local properties of analytical functions and definite integrals.
CLO2: Describe the concept of definite integral and harmonic functions.
CLO3: Demonstrate the concept of the general form of Cauchy's theorem
CLO4: Develop Taylor and Laurent series .
CLO5 Explain the infinite products, canonical products and Jensen'sformula .

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1			√			√				
CO2	√						√			
CO3									√	
CO4		√		√					√	
CO5			√			√				√

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SEMESTER III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">TOPOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M13</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>5</td><td>1</td><td>--</td><td colspan="3">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNITI :Topological spaces :Topological spaces – Basis for a topology – The order topology – The product topology on X × Y – The subspace topology – Closed sets and limit points.</td></tr>
<tr><td colspan="6">UNITII :Continuousfunctions:Continuous functions – The product topology – The metric topology.</td></tr>
<tr><td colspan="6">UNITIII :Connectedness:Connected spaces- Connected subspaces of the Real line - Compact spaces – compact subspaces of the Real line</td></tr>
<tr><td colspan="6">UNITIV :The countability axioms – The Separation axioms- Normal spaces - TheUrysohn lemma – The Urysohnmetrization theorem.</td></tr>
<tr><td colspan="6">UNITV: The Tychonoff theorem – The Stone-cechCompactificaion – Complete metric spaces – Compactness inmetric spaces.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text book</td><td colspan="6">James R. Munkres, Topology (2nd Edition) Pearson Education Ltd., Delhi, 2002 (Third Indian Reprint)
UnitI :Chapter 2 : Sections 12 to 17
UnitII :Chapter 2 : Sections 18 to 21 (Omit Section 22)
UnitIII:Chapter 3 : Sections 23 to 27 (except 25).
UnitIV:Chapter 4 : Sections 30 to 34.
UnitV :Chapter 4 : Sec 37 &38 Chapter 7: Sec 43 & 45</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. J. Dugundji ,Topology , Prentice Hall of India, New Delhi, 1975.
2. George F.Sinmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963
3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York
4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. S.Willard, General Topology, Addison - Wesley, Mass., 1970</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org</td></tr>
</table>

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able to

CLO1: Define and illustrate the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space. **CLO2**: Understand continuity, compactness, connectedness, homeomorphism and topological properties.

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

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

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

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√						
CO2						√	√			
CO3		√				√				
CO4										√
CO5			√		√					

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SEMESTER III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">GRAPH THEORY AND ITS APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M14</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td>--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Graph Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study the graph theoretical concepts and algorithms that help to model real life situations.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I :Graphs and Subgraphs: Graphs and Simple graphs – graph isomorphism – The incidence and adjacency matrices – Subgraphs – Vertex degrees – Paths and connections – Cycles. Trees: Trees–cut edges and bonds Cut vertices – Cayley’s formula.</td></tr>
<tr><td colspan="6">UNIT II : Connectivity: Connectivity – Blocks – Construction of reliable communication networks. Euler tour and Hamiltonian cycles: Euler tours – Hamilton cycles – The Chinese postman problem – The traveling salesman problem.</td></tr>
<tr><td colspan="6">UNIT III: Matchings - Matchings – Matchings and Coverings in bipartite Graphs - Perfect Matchings. Edge Colourings: Edge chromatic number – Vizing’s theorem.</td></tr>
<tr><td colspan="6">UNIT IV :Independent sets & cliques: Independent sets –Ramsey’s theorem – Turan’s theorem. Vertex Colourings: Chromatic number – Brook’s theorem –Hajos’ conjecture – Chromatic polynomials.</td></tr>
<tr><td colspan="6">UNIT V :Planar graphs: Plane and planar graphs – Dual graphs – Euler’s Formula– Bridges- Kuratowski’s Theorem – The five colour Theorem and four colour conjecture</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">J.A Bondy and U.S.R Murty, Graph Theory with Applications, North Holland, 1st Edition 1976.
Unit I : Chapters 1 & 2: 1.1 – 1.7 & 2.1 – 2.4
Unit II : Chapters 3 & 4 :3.1 – 3.3 & 4.1 – 4.4
Unit III : Chapters 5 &6 : 5.1 – 5.3 & 6.1, 6.2
Unit IV : Chapters 7 & 8: 7.1 – 7.3 & 8.1 – 8.4
Unit V : Chapter 9: 9.1- 9.6.</td></tr>
</table>

Reference Books	1. John Clark and D. Allan Holton; Graph theory, World Scientific Publishing Co. Pvt.Ltd, 1991. 2. Narsingh Deo; Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, 1974. 3. S.Kumaravel and Susheela Kumaravel, Graph Theory, SKV Publishing , 1st Edition, 1999.
Website and e-Learning Source	https://www.zib.de/groetschel/teaching/WS1314/BondyMurtyGTWA.pdf, http://ignited.in/I/a/252519, https://www.mygreatlearning.com/blog/application-of-graph theory/https://in.coursera.org/learn/graphs, https://neo4j.com/blog/top-13-resources-graph-theory-algorithms/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1:study the properties of Trees, Connectivity and Blocks with its applications.

CLO 2:discuss Euler tour, Hamiltonian cycles and its suitable applications.

CLO 3:understand the concepts of Matching's, Coverings and Perfect Matching's.

CLO 4:apply domain knowledge in Chromatic number, Brook's Theorem, Hajos' Conjecture and Chromatic polynomials.

CLO 5:define Directed graphs, Directed paths and Directed cycles and apply results to Practical problems.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√	√			√	√	√	√		
CO2		√	√			√	√	√		
CO3	√			√			√		√	
CO4	√	√			√	√	√			
CO5	√			√			√			√

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SEMESTER III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">OPTIMIZATION TECHNIQUES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M15</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td>--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Operations Research</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To enable the students to
1. Understand and apply some of the Techniques of Operations Research.
2. Study the advanced level topics in Linear Programming and Non linear programming, Integer and Dynamic programming problems.
3. Develop and promote research interest in applying optimization techniques in problems in engineering and Technology.
4. Learn basic optimization techniques in order to get best results for a set of several possible solutions of different problem viz linear programming problems Duality problem, Dual simplex method, integer programming problem and Dynamic problem and non linear programming problems.
5. Participate in various competitive examinations and application.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I: Duality in Linear programming:Introduction – General Primal – Dual Pair – Formulating a Dual problem – Primal – Dual pair in Matrix form – Duality Theorems – Complementary Slackness Theorem – Duality and Simplex method; Advanced Linear programming Techniques: Introduction -Revised simplex method.</td></tr>
<tr><td colspan="6">UNIT II:Integer Programming Problem : Introduction Gomory’s All – I.P.P. method – Construction of Gomory’s constraints-Fractional cut method-All integer - Fractional cut method- mixed integer – Branch and Bound method.</td></tr>
<tr><td colspan="6">UNIT III:Dynamic Programming: Introduction–The Recursive Equation Approach –Characteristics of Dynamic programming – Dynamicprogramming Algorithm – Solution of Discrete D.P.P – Some Applications - Solution to L.P.P by Dynamic Programming.</td></tr>
<tr><td colspan="6">UNIT IV:Simulation: Introduction - Why Simulation? – Methodology of Simulation – Simulation models – Event Type simulation - Generation of Random numbers – Monte Carlo Simulation.</td></tr>
<tr><td colspan="6">UNIT V: Non- Linear Programming: Introduction-Formulating a non-linear programming problem - General Non-linear Programming problem – Constrained optimization with equality constraints –Constrained optimization with inequality constraints. Graphical solution – Kuhn – Tucker conditions with non-negative constraints.</td></tr>
</table>

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Kanthi Swarup,P.K.Gupta and Manmohan, Operations Research, Eleventh Edition, 2003. Unit I:Chapter 5: Sec 5.1 to 5.7,Chapter 9: Sec 9.1,9.2 UnitII:Chapter 7: Sec 7.1 to 7.6 Unit III:Chapter 13: Sec 13.1 to 13.7 Unit IV:Chapter 23 : Sec 23.1 to 23.7 Unit V:Chapter 24:Sec 24.1 to 24.5 Chapter 25: Sec 25.2, 25.3
Reference Books	1. Hamdy A. Taha, Operations Research an Introduction, Pearson prentice hall, 8thEdition(2006) 2. O. L. Mangasarian, Non linear programming, Mc Graw Hill, Newyork, 1979. 3. Premkumar Gupta and D.S. Hira, Operations Research: An introduction, S.Chand, Delhi ,1979.
Website and e-Learning Source	

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand the theory of optimization methods and algorithms developed for solving various types of optimization problems.

CLO 2: Extend their knowledge of basic optimization techniques to do interesting research work on these types of optimization techniques.

CLO 3: Identify and know about simulation in operations research.

CLO 4: Highlight some of the applications of optimization techniques

CLO 5: Apply into real life problems.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√					√		√		
CO2		√		√		√				√
CO3			√						√	
CO4				√						
CO5					√		√			

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SEMESTER III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">STOCHASTIC PROCESSES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE COURSE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC V</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M16EC</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Operations Research</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To enable the students to
To Acquire the skill of advanced level of mathematical sophistication and enhancing the horizons of knowledge.
Apply Stochastic Models to various real life problems.
Extend the use of stochastic models in various areas..
Learn the idea of stochastic process and their classifications</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I:StochasticProcesses: Some Notions: Introduction – Specification of Stochastic Processes – Stationary Processes.</td></tr>
<tr><td colspan="6">UNIT II:MarkovChains:Definition and Examples – Higher Transition Probabilities- Generalization ofIndependent Bernoulli trials: Sequence of Chain DependentTrials.</td></tr>
<tr><td colspan="6">UNIT III:MarkovChains continued: Classification of States and Chains – Determination of Higher Transition Probabilities – Stability of a Markov System – Markov ChainwithDenumerable Number of States.</td></tr>
<tr><td colspan="6">UNIT IV:MarkovProcesses with Discrete State Space:PoissonProcess – Poisson Process and Related Distributions.</td></tr>
<tr><td colspan="6">UNIT V:RenewalProcesses and Theory:RenewalProcess – Renewal Processes in Continuous Time – Renewal Equation – Stopping Time: Wald’s Equation.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">J.Medhi,Stochastic Processes, Second Edition, New Age International(P) limited Publishers, New Delhi, 1994.
Unit I : Chapter 2: 2.1 to 2.3
Unit II : Chapter 3: 3.1 to 3.3
Unit III: Chapter 3: 3.4 to 3.6, 3.8.
Unit IV: Chapter 4: 4.1 to 4.2
Unit V : Chapter 6: 6.1 to 6.4</td></tr>
</table>

Reference Books	1. S. Karlin and H. M. Taylor, A First Course in Stochastic Processes, Academic Press, Second Edition, New York,2011. 2. S. M. Ross, Stochastic Processes, Second Edition, Wiley India Ltd, 2008.
Website and e-Learning Source	

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand the stochastic models for many real life probabilistic situations.

CLO 2: Gain working knowledge to the problem of uncertainty..

CLO 3: I Get a basic knowledge for doing research is this area.

CLO 4: Explain the concept of stationary and wide sense stationary and appreciate their significance.

CLO 5: Describe renewal process in continuous time using Wald's equation

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√		√		√		√		√	
CO2						√		√		√
CO3		√		√						
CO4			√			√	√	√		√
CO5	√		√			√	√	√		√

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SEMESTER III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">ALGEBRAICNUMBERTHEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE COURSE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC V</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M16EC</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level Operations Research</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To enable the students to
To Acquire the skill of advanced level of mathematical sophistication and enhancing the horizons of knowledge.
Toexposethestudentstothecharm,nicetiesandnuancesintheworldof numbers.

TohighlightsomeoftheApplicationsoftheTheoryofNumbers.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">Unit I:Introduction–Divisibility–Primes–TheBinomialTheorem–Congruences –Euler'stotient-Fermat's,Euler'sandWilson'sTheorems–Solutionsofcongruences–TheChineseRemaindertheorem.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT II: Techniquesofnumericalcalculations–Publickeycryptography–PrimepowerModuli–PrimitiverootsandPowerResidues–Congruencesofdegreetwo.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT III: NumbertheoryfromanAlgebraicViewpoint–Groups,ringsandfields–QuadraticResidues-TheLegendresymbol(a/r)whererisanoddprime –QuadraticReciprocity–TheJacobiSymbol(P/q)whereqis an odd positiveinteger.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT IV: BinaryQuadraticForms–EquivalenceandReductionofBinaryQuadraticForms–Sumsofthreesquares–PositiveDefiniteBinaryQuadraticforms–GreatestintegerFunction–ArithmeticFunctions–TheMobiusInversionFormula–RecurrenceFunctions–Combinatorialnumbertheory.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT V: DiophantineEquations–Theequation$ax + by = c$–SimultaneousLinearDiophantineEquations–PythagoreanTriangles–Assortedexamples.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	IvanNiven,HerbertS,ZuckermanandHughL,Montgomery, AnIntroductiontotheTheoryofNumbers,Fifthedn.,JohnWiley&SonsInc,2004. UnitI :Chapter1andChapter2:Sec2.1to2.3 UnitII :Chapter2:Sec2.4to2.9 UnitIII: Chapter2:Sec2.10,2.11Chapter3:Sec3.1to3.3 UnitIV:Chapter3:Sec3.4to3.7andChapter4 UnitV: Chapter5:Sec5.1to5.4.
Reference Books	1. ElementaryNumberTheory,DavidM.BurtonW.M.C. BrownPublishers,Dubuque,Lawa,1989. 2. NumberTheory,GeorgeAndrews,CourierDoverPublications,1994. 3. Fundamentals of Number Theory, William J. Leveque Addison-WesleyPublishingCompany,Phillipines,1977.
Website and e-Learning Source	1. http://www.math.toronto.edu/~ila/Neukirch_Algebraic_number_theory.pdf 2. https://www.pdfdrive.com/download.pdf?id=188938191&h=4d0f9c871d3eb049e961899e1123111b&u=cache&ext=pdf

Course Learning Outcome (for Mapping with POs and PSOs)

CLO 1: Understandandworknumerousproblemsonconceptsofdivisibilityandprimes.
CLO 2:
GainexpertiseinEuler'stotient,Fermat's,Euler'sandWilson'sTheoremsandworkon applicationsillustratingthem.
CLO 3:
Understandnumbertheoryfromalgebraicpointofviewthereby improvingtheirsense ofabstraction.
CLO 4: Attainedmasteryinthefundamentalsofgreatestintegerfunctionandrecurrencefunctionsandattackingcombinatorialproblemsusingthem.
CLO 5: SolvesimplesimultaneouslinearDiophantineequations.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√		√		√		√		√	
CO2						√		√		√
CO3		√		√						
CO4			√			√	√	√		√
CO5	√		√			√	√	√		√

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SEMESTER - III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NEURAL NETWORKS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE COURSE</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M16EC</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic skills in networks.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To get artificial intelligence with the help of networks.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I: Basics of Artificial Neural Networks, Characteristics of Neural Networks, Historical Development of Neural Network Principles.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit II: Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Activation and Synaptic Dynamics, Activation Dynamics Models.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit III:Synaptic Dynamics Models, Learning Methods, Stability and Convergence. Functional Units of ANN for Pattern Recognition Tasks, Pattern Recognition Problem.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit IV:Basic Functional Units, Pattern Recognition Tasks by the Functional, Feedforward Neural Networks, Analysis of Pattern Association Networks, Analysis of Pattern Classification Networks.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit V: Feedback Neural Networks, Analysis of Linear Autoassociative FF Networks, Analysis of Pattern Storage Networks.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Getting knowledge in artificial intelligence using Networks.
Recommended Text	R. Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, 2005, 2, 3. Unit I: Chapter 1 Unit II: Chapter 2 Unit III: Chapter 3 Unit IV: Chapter 4-4.1 to 4.3 Unit V:Chapter 5-5.1 to 5.3
Reference Books	1. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer 2. Adam Gibson and Josh Patterson, Deep Learning: A Practioner's Approach, First Edition
Website and e-Learning Source	-

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand the Basics of Artificial Neural Networks.

CLO 2: Understand the Basic Learning Laws and Activation Dynamic Models.

CLO 3: Deal with Pattern Recognition Problems.

CLO 4: Analyze Feedforward Neural Networks, Pattern Association Networks and Pattern Classification Networks.

CLO 5: Deal with Feedback Neural Networks, Linear Autoassociative FF Networks and Analysis of Pattern Storage Networks.

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√	√	√				√
CO2				√			√			
CO3	√		√					√		
CO4										
CO5					√					√

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SEMESTER - III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">TENSOR ANALYSIS AND RELATIVITY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M16EC</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Instructional Hours per week (hrs)</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>2</td><td colspan="2">1</td><td>-</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic knowledge in Analytical geometry</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">After successful completion of the course students should be able to understand the basics concepts of Tensor in various fields like CartesianTensor,Tensor in Physics, and Tensor in Analytic Solid Geometry, General Tensor, Tensor in Relativity and Geodesics and Its Coordinate.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I: Cartesian Tensor: Introduction- Transformation of Coordinates- Relations Between the Direction Cosines- Transformation of Velocity Components - First-Order Tensors - Second-Order Tensors - Notation for Tensors - Algebraic Operations on Tensors- Sum and Difference of Tensors - Product of Tensors - Quotient Law of Tensors-Contraction Theorem - Symmetric and Skew-Symmetric Tensor- Alternate Tensor- Kronecker Tensor - Relation Between Alternate and Kronecker Tensors- Matrices and Tensors of First and Second Orders - Product of Two Matrices- Scalar and Vector Inner Product - Two Vectors - Scalar Product- Vector Product- Tensor Fields - Gradient of Tensor Field - Divergence of Vector Point Function - Curl of Vector Point Function- Tensorial Formulation of Gauss's Theorem - Tensorial Formulation of Stoke's Theorem.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit II: Tensor in Physics: Kinematics of Single Particle - Momentum - Acceleration - Force - Kinetic Energy and Potential Energy - Work Function and Potential Energy - Momentum and Angular Momentum - Moment of Inertia - Strain Tensor at Any Point - Stress Tensor at any Point P - Normal Stress - Simple Stress - Shearing Stress -Generalised Hooke's Law - Isotropic Tensor</td></tr>
</table>

	Unit III: Tensor in Analytic Solid Geometry**:** Vector as Directed Line Segments -Geometrical Interpretation of the Sum of two Vectors - Length and Angle between Two Vectors - Geometrical Interpretation of Scalar and Vector Products -Scalar Triple Product - Vector Triple Products - Tensor Formulation of Analytical Solid Geometry - Distance Between Two Points P(xi) and Q(yi) - Angle Between Two Lines with Direction Cosines -The Equation of Plane - Condition for Two Line Coplanar.
	Unit IV: General Tensor**:** Curvilinear Coordinates - Coordinate Transformation Equation - Contravariant and Covariant Tensor - Contravariant Vector or Contravariant Tensor of Order-One - Covariant Vector or Covariant Tensor of Order-One - Mixed Second-Order Tensor - General Tensor of Any Order - Metric Tensor - Associate Contravariant Metric Tensor - Associate Metric Tensor - Christoffel Symbols of the First and Second Kind- Covariant Derivative of a Covariant Vector - Covariant Derivative of a Contravariant Vector .
	Unit V: Tensor in Relativity - Special Theory of Relativity - Four-Vectors in Relativity - Maxwell's Equations - General Theory of Relativity - Spherically Symmetrical Metric- Planetary Motion ; Geodesics and Its Coordinate - Families of Curves - Euler's Form-Geodesics - Geodesic Form of the Line Elements - Geodesic Coordinate.
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 Class hour)
Skills acquired from this course	Knowledge, Problem Solving
Recommended Text	AN INTRODUCTION TO TENSOR ANALYSIS, Dr. Bipin Singh Koranga and Dr. Sanjay Kumar Padaliya, *Published, sold and distributed by* River Publishers-Alsbjergvej 10. 9260 Gistrup , Denmark. Unit I: Chapter 2 Unit II: Chapter 3 Unit III: Chapter 4 Unit IV: Chapter 5 Unit V: Chapter6 & 7

Reference Books	1. Harold Jeeffreys (1931), Cartesian Tensors, PP(1-16), Cambridge University Press(New York) 2. David C. Kay, Theory and Problem of Tensors Calculus, PP(1-3). McGraw Hill, Washinton, D.C. 3. Shanti Narayan (1961), Cartesian Tensors, PP(1-12), S.chand, New Delhi. 4. DE Bourine and PC Kendell (1967), Vector Analysis and Cartesian Tensor, PP(245-257), Chapman &Hall. 5. Barry Spain (1960), Tensor Calculus, PP(1-55), Dover Publication, Newyork. 6. A.J. McConnell (1960), Application of Tensor Analysis, PP(1-9)Khosla Publication, New Delhi. 7. Zefer Ahson (2000), Tensor Analysis with Applications,Anamaya Publisher, New Delhi. 8.U.C. De (2008), Tensor Calculus, PP(1-9), Narosa Publishing House, New Delhi.
Online reference	ISBN: 978-87-7022-581-6 (Hardback) 978-87-7022-580-9 (Ebook)

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Cartesian Tensor

CLO 2: Tensor in Physics

CLO 3: Tensor in Analytic Solid Geometry

CLO 4: General Tensor

CLO 5: Tensor in Relativity

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√				√	√				√
CO2				√			√			
CO3	√		√							
CO4		√				√			√	
CO5					√					√

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SEMESTER - III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PRACTICALS IN C++</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC -II</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23P3M17SEC</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">-</td><td colspan="2">-</td><td>3</td><td>3</td></tr>
</table>

1 ALIGNMENT
2 VIRTUAL FUNCTIONS
3 VIRTUAL BASE CLASS
4 STACK AS AN ARRAY
5 STACK AS LINKED LIST
6 QUEUE
7 QUEUE AS LINKED LIST
8 HEAPSORT
9 MERGESORT
10 QUICKSORT

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SEMESTER IV

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FUNCTIONAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P4M18</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>5</td><td>1</td><td>--</td><td colspan="3">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems. To develop student’s skills and confidence in mathematical analysis and proof techniques.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNITI :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.</td></tr>
<tr><td colspan="6">UNITII :Hilbert Spaces: The definition and some simple properties– Orthogonal complements–Ortho normal sets–The conjugate space H^*.</td></tr>
<tr><td colspan="6">UNITIII :Operators on Banach and Hilbert Spaces:The adjoint of an operator–self-adjoint operators-Normal and unitary operators .</td></tr>
<tr><td colspan="6">UNITIV :Projections: Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator –The spectral theorem.</td></tr>
<tr><td colspan="6">UNITV: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.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">G.F.Simmons, Introduction to Topology and Modern Analysis,
McGraw Hill Education (India)Private Limited, New Delhi, 1963.
UnitI :Chapter 9:Sections 46-51
UnitII :Chapter10:Sections52-55
UnitIII:Chapter 10:Sections 56-58
UnitIV:Chapter 10 : 59, Chapter11 : 60 – 62
UnitV :Chapter 12:Sections 64-68</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.
2. B.V. Limaye, Functional Analysis, New Age International,1996.
3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987.
4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://en.wikiepedia.org</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

CLO2: Prove Hahn Banach theorem and open mapping theorem.

CLO3: Describe operators and fundamental theorems.

CLO4: Validate orthogonal and orthonormal sets.

CLO5: Analyze and establish the regular and singular elements.

OUTCOMES MAPPING:

Course	Programme Outcomes					Programme Specific Outcomes				
Outcomes	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√			√		√				
CO2				√			√			
CO3			√					√		
CO4		√							√	
CO5					√					√

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SEMESTER IV

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DIFFERENTIAL GEOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE XII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23P4M19</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hoursper week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td>--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Calculus and Differential Equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surface and the differential geometry of surfaces are explored</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I :Curves in the plane and in space:Curves, Parametrisation, arc length, Level, curves, curvature, plane and space curves.</td></tr>
<tr><td colspan="6">UNIT II:Surfaces in space:Surface patches, smooth surfaces, tangents, Normals orientability, examples ofsurfaces, lengths of curves on surfaces, the first fundamental form, isometries, surface area.</td></tr>
<tr><td colspan="6">UNIT III: Curvature of surfaces:The second fundamental form, Curvature of curves on a surface,normal, principal, Gaussian and mean curvatures, Gauss map.</td></tr>
<tr><td colspan="6">UNIT IV:Geodesics :Geodesics, geodesic equations, geodesics as shortest paths, geodesic coordinates.</td></tr>
<tr><td colspan="6">UNIT V:Gauss’s TheoremaEgregium:Gauss’s remarkable Theorem, Isometries of surfaces, Codazzi-Mainardi equations, compact surfaces of constant Gaussian curvature.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Andrew Pressley, Elementary Differential Geometry, Second Edition, Springer Undergraduate MathematicsSeries, 2010.
Unit I :Chapters 1 and 2
Unit II :Chapter 4 - 4.1, 4.2, 4.3, 4.4, 4.7 and
Chapter 5 - 5.1, 5.2, 5.4
Unit III:Chapter 6 - 6.1, 6.2, 6.3 and Chapter 7 - 7.1, 7.5,7.6
Unit IV:Chapter 8 - 8.1, 8.2, 8.4, 8.5
Unit V:Chapter10</td></tr>
</table>

Reference Books	1. T.J. Willmore, An Introduction to Differential Geometry, Oxford University Press,(17th Impression) New Delhi 2002. Struik, D.T. Lectures on Classical Differential Geometry, Addison - Wesley, Mass.1950. 2. Kobayashi S. and Nomizu. K. Foundations of Differential Geometry, Interscience Publishers, 1963. 3. Wihelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer Verlag, 1978. 4. J.A. Thorpe Elementary topics in Differential Geometry, Under – graduate Texts in Mathematics, Springer - Verlag 1979.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

CLO2: Evaluate these concepts with related examples.

CLO3: Compose problems on geodesics.

CLO4: Recognize applicability of developable.

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

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1						√				
CO2			√				√			
CO3					√					√
CO4		√					√			
CO5				√				√		

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SEMESTER IV

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">CLASSICAL DYNAMICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE COURSE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC VI</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P4M20EC</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td>--</td><td colspan="3">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Mechanics concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To Learn various fundamental concepts of mechanical systems like co-ordinates, constraints, etc.Introduce various kinds of forces acting in a mechanical system.Demonstrate the various kinds equation of motion of a system.Explore the applications of Lagrange’s equations and various functions. Study the solution of equation of motion for a system and learn example Problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I:Introductory concepts: The mechanical systems- Generalized coordinates – Constraints – Virtual work-D’ Alembert’s principle-Examples.</td></tr>
<tr><td colspan="6">UNIT II :Lagrange’s equations: Energy and momentum –Lagrange’s equations - Derivation of Lagrange’s Equations –Examples.</td></tr>
<tr><td colspan="6">UNIT III:Integrals of the motion: Special applications of Lagrange’s Equations –Rayleigh’s Dissipation function.</td></tr>
<tr><td colspan="6">UNIT IV:Hamilton’s equations: Impulsive motion –Hamilton’s Principle Hamilton’s Equations.</td></tr>
<tr><td colspan="6">UNIT V:Other variational Principles : Hamilton’s Principles Function – TheHamilton -Jacobi Equation – Separability.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Donald T. Greenwood, Classical Dynamics, Doverpublications, INC., 1977.
UnitI :Chapter 1: 1.1 to 1.4
UnitII :Chapter 1: 1.5 & Chapter 2: 2.1,2.2
Unit III: Chapter 2: 2.3 & Chapter 3: 3.1
Unit IV: Chapter 3: 3.2 & Chapter 4: 4.1 & 4.2
UnitV:Chapter 4: 4.3 & Chapter 5: 5.1 to 5.3.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1.H.Goldstein, Classical Mechanics(Second Edition), Narosa Publishing House, New Delhi,1998.
2.Narayan Chandra Rana and Promod Sharad Chandra Joag, Classical Mechanics, Tata Mc Graw Hill,1991.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to
CLO1: Understand the basic concepts and various principles of a mechanical system.
CLO2: Learn various functions like Lagrange's, Hamiltonian's, Rayleigh's functions on mechanical systems.
CLO3: Understand the derivations of Lagrange's , Hamiltonian- Jacobi equations.
CLO4: Study the motion of various mechanical systems.
CLO5: Solve the integrals or solutions of equation of motions.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√	√				√				
CO2			√				√			√
CO3				√			√	√		
CO4	√					√				
CO5		√		√		√				√

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SEMESTER IV

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FINANCIALMATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE COURSE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ECVI</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P4M20EC</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Mechanics concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study financial mathematics through various models.
To study the various aspects of financial mathematics.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT I: Single Period Models:Definitions from Finance - Pricing a forward - One-step Binary Model - a ternary Model - Characterization of no arbitrage - Risk-Neutral Probability Measure.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT II : Binomial Trees and Discrete Parameter Martingales:Multi-periodBinarymodel-AmericanOptions-DiscreteparametermartingalesandMarkov processes-MartingaleTheorems-BinomialRepresentationTheorem-Overture to Continuous models.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT III:Brownian Motion:Definition of the process - Levy's Construction of Brownian Motion-TheReflectionPrincipleandScaling-MartingalesinContinuoustime.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITIV:StochasticCalculus:Non-differentiabilityofStockprices-StochasticIntegration- Ito's formula - Integration by parts and Stochastic Fubini Theorem - Girsanov Theorem - Brownian Martingale Representation Theorem – GeometricBrownian Motion - The Feynman - Kac Representation.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT V:Block-SholesModel:BasicBlock-SholesModel-Block-Sholespriceand hedgeforEuropeanOptions-ForeignExchange-Dividends-Bonds-Market price of risk.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	AlisonEtheridge,ACourseinFinancialCalculus,CambridgeUniversity Press, Cambridge, 2002. UnitI :Chapter 1 UnitII :Chapter2 Unit III: Chapter 3 Unit IV: Chapter 4 UnitV:Chapter5
Reference Books	1. MartinBoxterandAndrewRennie,FinancialCalculus:AnIntroductionto DerivativesPricing,CambridgeUniversityPress,Cambridge,1996. 2. DamienLambertonandBernardLapeyre,(TranslatedbyNicolasRabeauandFarancoisMantion), 3. IntroductiontoStochasticCalculusAppliedtoFinance,ChapmanandHall, 1996.
Website and e-Learning Source	1. ttps://archive.org/details/financialmathema032436mbp

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to
CLO1: Usediscreteandcontinuousprocessesinfinancialmodeling.
CLO2: Gainknowledgeintherelationshipbetweenstochasticanddeterministic models.
.**CLO3**: UnderstandtherolesofPutandCalloptionsinriskreductionalso understand hedging strategies to reduce risk.
CLO4: Understand the role of the Black-sholes partial differential equation and its boundary and final conditions in option pricing.
CLO5: Solve theBasicBlock-SholesModel and ForeignExchange

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√	√				√				
CO2			√				√			√
CO3				√			√	√		
CO4	√				√	√				
CO5		√		√		√				√

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SEMESTER IV

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">RESOURCEMANAGEMENTTECHNIQUES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE COURSE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ECVI</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P4M20EC</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td>--</td><td colspan="3">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Operations Research</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. Develop an understanding of mathematics in real time situations.
2. Know the communication of mathematical ideas and techniques.
3. Understand mathematical methods used in OR.
4. Apply these techniques constructively to make effective business decisions.
5. Participate in various competitive examinations and application.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I:GAMETHEORY:GameTheory-Two personZerosum games-Saddle point, DominanceRule, ConvexLinearCombination(Averages),methods ofmatrices, graphical andLP Solutions.</td></tr>
<tr><td colspan="6">UNIT II :SEQUENCING PROBLEMS: Problem of Sequencing – Problems with n Jobs and Two machines- Problems with n Jobs and Three machines - Problems with n Jobs and m machines – Graphical solution</td></tr>
<tr><td colspan="6">UNIT III: PROBABILITY,MARKOV ANALYSIS AND FINITE DIFFERENCES: Definition of probability – Algebra of Events -Conditional Probability – Random variables- Expectation of Random variables- Some probability distributions.</td></tr>
<tr><td colspan="6">UNITIV:Stochastic Process- Markov process- Markov Analysis- Finite Differences- Application of finite differences.</td></tr>
<tr><td colspan="6">UNIT V:QUEUEING THEORY:Queueing system- Characteristics of Queueing system- Symbols and Notations- Poisson Process and Exponential Distribution- Classification of Queues- Definition of Transient and steady states- Poisson Queues.</td></tr>
</table>

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Kanthi Swarup,P.K.Gupta and Manmohan, Operations Research, Eleventh Edition, 2003. UnitI: Chapter 9 : Section 9.1 to 9.5 UnitII: Chapter 10: Section 10.1 to 10.6 Unit III: Chapter 15: Section 15.1 to 15.7 Unit IV: Chapter 15: Section 15.8 to 15.12 UnitV: Chapter 16: Section 16.1 to 16.8
Reference Books	1) Prem Kumar Gupta, D.S. Hira, "Operations Research", S.Chand& Company Ltd,NewDelhi, 3rdEdition ,2008. 2) JohnW.Chinneck"FeasibilityandInfeasibilityinOptimizationAlgorithmsandComputationalMethods'Springer, 2008. **3)** Ravindran,Phillips,Solberg,"OperationsResearch:PrinciplesAndPractice",2NDED,JohnWiley& Sons,
Website and e-Learning Source	2. ttps://archive.org/details/financialmathema032436mbp

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand the theory of optimization methods and algorithms developed for solving various types of optimization problems.

CLO 2: Extend their knowledge of basic optimization techniques to do interesting research work on these types of optimization techniques.

CLO 3: Analyzethegametheorytechniquesinmathematicalmodelsofstrategicinteraction betweenrationaldecision-makers.

CLO 4: Highlight some of the applications of optimization techniques

CLO 5: Apply into real life problems.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√	√				√				
CO2			√				√			√
CO3				√			√	√		
CO4	√				√	√				
CO5		√		√		√				√

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M.Sc., MATHEMATICS

(Effective for those admitted from 2023-2024 onwards)

SEMESTER IV

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ALGEBRAICGEOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE COURSE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC VI</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23P4M20EC</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Operations Research</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study geometric problems of higher complexity then other nearby fields.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I:Affine Varieties:Introduction-affinevarieties-Hilbert’sNullstellensatz-polynomialfunctionsandmaps.</td></tr>
<tr><td colspan="6">UNIT II:Projective Varieties:Rationalfunctionsandmaps-projectivespace-varieties-rationalfunctionsandmorphisms.</td></tr>
<tr><td colspan="6">UNIT III: Smooth Points and Dimension: Smoothandsingularpoints-algebraiccharacterizationsofthedimensionofavariety.</td></tr>
<tr><td colspan="6">UNITIV:Plane Cubic Curves:Planecurves- Intersectionmultiplicity-classificationofsmoothcubics-Thegroupstructureofanellipticcurve.</td></tr>
<tr><td colspan="6">UNIT V: Cubic Surfaces:The existence of lines on a cubic-configuration of the 27 lines- rationality ofcubics</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Elementary Algebraic Geometry, K. Hulek (translated by H. Verrill), StudentMathematical Library, vol 20, American Mathematical Society, 2003.
UnitI : Chapter 1 : Section 1.1 to 1.3
UnitII : Chapter 2: Section 2.1 to 2.3
Unit III: Chapter 3: Section 3.1 to 3.2
Unit IV: Chapter 4: Section 4.1 to 4.4
UnitV : Chapter 5: Section 5.1 to 5.3</td></tr>
</table>

Reference Books	**References** 1. IntroductiontoAlgebraicGeometry,BrendanHassett,CambridgeUniversityPress,2007. 2. AlgebraicGeometry,R.Hartshorne,Springer-Verlag,1977. 3. AlgebraicGeometry:AFirstCourse,J.Harris,Springer-Verlag,1992. 4. AlgebraicCurves:An IntroductiontoAlgebraic Geometry,William Fulton,AdvancedBookProgram,RedwoodCity,Addison-Wesley,1989. 5. PrinciplesofAlgebraicGeometry,PhillipGriffithsandJosephHarris, NewYork: Wiley-Interscience,1978.
Website and e-Learning Source	ttps://archive.org/details/financialmathema032436mbp

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to
CLO 1: Analyze and evaluate Affine Varieties.
CLO 2: Describe the concepts of Smooth Points and Dimension.
CLO 3: Analyzethegametheorytechniquesinmathematicalmodelsofstrategicinteraction betweenrationaldecision-makers.
CLO 4: Highlight some of the applications of Plane Cubic Curves
CLO 5: Demonstrate the concept onCubic Surfaces.

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√	√				√				
CO2			√				√			√
CO3				√			√	√		
CO4	√				√	√				
CO5		√		√		√				√

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SEMESTER IV

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PROBABILITY AND STATISTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">SKILL ENHANEMENT COURSE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC III</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23P4M21SEC</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level Modern Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT I :Probability: The probability set function –Conditional Probability and independence – Randomvariables of the discrete type – Random variables of thecontinuous type</td></tr>
<tr><td colspan="7">UNIT-II:Distribution:Properties of the distribution function – Expectation of Random Variable – Some Special Expectations-Chebyshev’s Inequality.</td></tr>
<tr><td colspan="7">UNIT III :MultivariateDistributions:Distributions of two Random Variables – conditional distributions and expectations – the correlation coefficient – Independent random variables Linear</td></tr>
<tr><td colspan="7">UNITIV : Some special Distributions: The Binomial and related distributions – The Poisson distribution– The Gamma and Chi-square distributions – The Normal distributions.</td></tr>
<tr><td colspan="7">UNIT V:Distributions of functions of Randomvariables: Sampling Theory – Transformations of variables of the discrete type – Transformationsofvariables of the continuous Type – The Beta, t and F distributions.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">Robert V.Hogg and AllenT. Craig, Introduction to Mathematical Statistics, Fifth edition, Pearson Education Asia 2002.
Unit I: Chapter 1: Sections 1.3 to 1.6
Unit II:Chapter 1: Sections 1.7 to 1.10
Unit III:Chapter 2: Sections 2.1 to 2.4
Unit IV:Chapter 3: Sections 3.1 to 3.4
Unit V:Chapter 4: Sections 4.1 to 4.4</td></tr>
</table>

Reference Books	1.K.L.Chang ,A Course in Probability, Academic Press, New York,1st Edition(2001). 2. M.Fisz, Probability theory and Mathematical Statistics, John- Wiley and Sons, New York, 3rd Edition(1963). 3. J.E.Freund, Mathematical Statistics, Prentice Hall of India,3rd Edition (2001).
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://www.probability.net

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

OUTCOMES MAPPING:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	√		√	√		√	√	√		
CO2		√		√		√		√		√
CO3			√			√				
CO4	√			√			√		√	√
CO5					√					