(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ALGEBRAIC STRUCTURES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE 1</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">T1PMAC1</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">-</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Modern Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms.</td></tr>
<tr><td colspan="2" rowspan="5">Course outline</td><td colspan="8">UNIT-I: Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, second proof only).
Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)</td></tr>
<tr><td colspan="8">UNIT-II : Solvable groups - Direct products - Finite abelian groups - Modules
Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5</td></tr>
<tr><td colspan="8">UNIT-III :Poynomial rings – polynomials over the rational field - polynomials over commutative rings
Chapter 6: Sections 3.9, 3.10, 3.11</td></tr>
<tr><td colspan="8">UNIT-IV :Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.
Chapter 6: Sections 6.4, 6.5</td></tr>
<tr><td colspan="8">UNIT-V: Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.
Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from the course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">I.N.Herstein.TopicsinAlgebra(IIEdition)WileyEastern Limited, New Delhi, 1975.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="8">1. M.Artin, Algebra, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic AbstractAlgebra(II Edition)
Cambridge University Press, 1997. (IndianEdition)
3. I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996);</td></tr>
</table>

	Vol.II Rings, Narosa Publishing House , New Delhi, 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental ofAbstract Algebra, McGraw Hill (International Edition), NewYork. 1997. 5. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman (1980);alsopublishedby HindustanPublishingCompany,NewDelhi.
Web resources	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com

Course Outcomes:

Students will be able to

CO1: Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems to find number of Sylow subgroups.

CO2: Define direct products, examine the properties of finite abelian groups, define modules, define solvable groups.

CO3: 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.

CO4: Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary divisors of transformation, apply the concepts to find characteristic polynomial of linear transformation.

CO5: 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 is Hermitian, Unitary and Normal.

(For students admitted from 2023- 2024)

Mapping of Cos with Pos and PSOs :

	Pos						**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">REAL ANALYSIS I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE 2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td colspan="2">I</td><td>Credits</td><td>5</td><td>Course Code</td><td colspan="2">T1PMAC2</td></tr>
<tr><td>Semester</td><td colspan="2">I</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its inter play between various limiting operations.</td></tr>
<tr><td colspan="2">Course outline</td><td colspan="8">Unit – I
Functions of bounded variation - Introduction –Properties of monotonic functions – Functions of bounded variation –Totalvariation -Additive property of total variation - Total variation on [a,x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions – Continuous functions of bounded variation.
Chapter 6 : Sections6.1 to 6.8
InfiniteSeries:Absoluteandconditionalconvergence-Dirichlet'stest and Abel's test – Rearrangement of series -Riemann's theorem on conditionally convergent series.
Chapter 8 : Sections8.8, 8.15, 8.17, 8.18</td></tr>
<tr><td colspan="2"></td><td colspan="8">Unit – II
The Riemann-Stieltjes Integral-Introduction-Notation- The definition of the Riemann -Stieltjes integral - Linear Properties -Integration by parts –Change of variable in a Riemann-Stieltjes integral – Reduction to a Riemann Integral–Euler’s summation formula-monotonically increasing integrators,Upper and lower integrals - Additive and linearity properties of upper, lower integrals -Riemann's condition - Comparison theorems.
Chapter 7 : Sections7.1 to 7.14</td></tr>
<tr><td colspan="2"></td><td colspan="8">Unit – III
The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems - integrals as a function of the interval -Second fundamental theorem of integral calculus-Change of variable – SecondMeanValueTheoremforRiemannintegral-Riemann-Stieltjesintegralsdependingonaparameter – Differentiation under integral sign –Lebesgue criteriaon for existence of Riemann integrals.
Chapter 7 :Sections 7.15 to 7.26</td></tr>
<tr><td colspan="2"></td><td colspan="8">Unit – IV
Infinite Series and infinite Products – Double sequences – Double series-Rearrangement theorem for double series-A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products.
Chapter 8: Sections 8.20, 8.21 to 8.26</td></tr>
</table>

(For students admitted from 2023- 2024)

	Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem **Chapter 9 : Sections 9.149.15, 9.19, 9.20, 9.22, 9.23**
	Unit – V Sequences of Functions - Pointwise convergence of sequences of functions - Examples of sequences of real-valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration-Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence. **Chapter 9: Sections 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Tom **M.** Apostol : Mathematical Analysis, 2nd edition, Addison Wesley Publishing Company Inc. New York,1974
Reference Books	1. Bartle, R.G. Real Analysis, John Wiley and Sons Inc., 1976. 2. Rudin, W. Principles of Mathematical Analysis, 3" Edition McGrawHill Company, New York, 1976. 3. Malik S.C. and Savita Arora Mathematical Anslysis, Wiley Eastern Limited New Delhi, 1991. 4. Sanjay Arora and BansiLal, Introduction to Real Analysis, SatyaPrakashan, New Delhi, 1991. 5. Gelbaum, B.R. and J. Olmsted, Counter Examples in Analysis,Holden day. San Francisco, 1964. 6. A.L. Gupta and NR.Gupta, Principles of Real Analysis, Pearson Education, (Indian print) 2003
Web resources	1. http://mathforum.org 2. http://ocw.mit.edu/ocwweb/Mathematics 3. http://www.opensource.org, www.mathpages.com

(For students admitted from 2023- 2024)

Course Outcomes:

Students will be able to

CO1: Analyze and evaluate functions of bounded variation and Rectifiable Curves..

CO2: Describe the concept of Riemann-Stieltjes integral and its properties.

CO3: Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.

CO4: Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem

CO5: Formulate the concept and properties of inner products, norms and measurable functions

MappingofCOswithPOsandPSOs :

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<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 3</td></tr>
<tr><td>Category</td><td>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">T1PMAC3</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per Week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">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">Course Outline</td><td colspan="6">Unit–I: Linear Equations with Constant Coefficients
The second order homogeneous equation – Initial value problems for second order equations - Linear dependence and independence - A formula for the Wronskian .
Chapter2 : Sections 1 to 5</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit–II: Linear Equations with Constant Coefficients
The non homogeneous equation of order two-Homogeneous and non-homogeneous equation of order n.
.Chapter 2: Sections 6 to 10</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit–III: Linear Equations with Variable Coefficients
Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.
Chapter3: Sections 4 to 8</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit–IV: Linear Equations with Regular Singular Points
Euler equation – Second order equations with regular singular points – Exceptional cases – Bessel Function.
Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit–V: Existence and Uniqueness of Solutions to First Order Equations
Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.
Chapter 5: Sections 1 to 6 (Omit Sections 7 to 9)</td></tr>
<tr><td colspan="2">Extended Professional Component(isapart ofinternalcompone ntonly,NottobeincludedintheExternalExamination 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 the course</td><td colspan="6">Knowledge, Problem Solving, Analyticalability,ProfessionalCompetency,ProfessionalCommunicationandTransferrable Skill</td></tr>
</table>

(For students admitted from 2023- 2024)

Recommended Texts	E.A.Coddington- *AnIntroductiontoOrdinaryDifferentialEquations*,Prentice-Hall of India Private Limited New Delhi - 2005. (Units I to V)
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
Web resources and e-Learning Source	http://mathforum.org http://ocw.mit.edu/ocwweb/Mathematics

Course Outcomes

Students will be able to

CO1:Establish the qualitative behavior of solutions of systems of differential equations.

CO2: Recognize the physical phenomena modeled by differential equations and dynamical systems.

CO3:Analyze solutions using appropriate methods and give examples

CO4:Formulate Green's function for boundary value problems

CO5: Understand and use various theoretical ideas and results that underlie the mathematics in this course.

Mapping of Cos with Pos and PSOs :

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">GRAPH THEORY AND ITS APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">EC 1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC</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">TPMAECA</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">-</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Basic concepts of Graph theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">Graph Theory is a growing field of Mathematics with applications in almost all the fields. This contains the beauty of abstract mathematics and applied mathematics. This is one of the most important Research areas.
• To attain basic knowledge of operations on graphs and connectivity.
• To have sound knowledge about Trees, Eulerian and Hamiltonian Graphs.
• To obtain the Practical knowledge about Matchings, Planar &Nonplanar Graphs</td></tr>
<tr><td colspan="2" rowspan="5">Course outline</td><td colspan="8">Unit – I
Graphs: Basic concepts - Paths and connectedness - Automorphism of a simple graph - Line graphs – Operations on graphs.
Chapter 1 (Sec 1.4- 1.7)</td></tr>
<tr><td colspan="8">Unit – II
Directed graphs: Basic concepts – Tournaments. Connectivity: Introduction - Vertex cuts and Edge cuts – Connectivity and Edge - connectivity.
Chapter 2 (Sec 2.1 &2.2) & Chapter 3 (Sec 3.0- 3.2)</td></tr>
<tr><td colspan="8">Unit – III
Trees: Definition, Characterization and Simple Properties – Centers and Centroids Counting Number of spanning Trees.
Chapter 4 (Sec 4.1 - 4.3)</td></tr>
<tr><td colspan="8">Unit – IV

Trees: Definition, Characterization and Simple Properties – Centers and Centroids Counting Number of spanning Trees.
Chapter 5 (Sec 5.1& 5.3) & Chapter 6 (Sec 6.1 &6.2)</td></tr>
<tr><td colspan="8">Unit – V
Planarity: Planar and Nonplanar graphs – Euler formula and its consequences - and are Nonplanar Graphs-Dual of a Plane graph.

UNITV: Chapter 8 (Sec 8.1- 8.4)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the</td><td colspan="8">Real life application related to the above topics in various fields.

(To be discussed during the Tutorial hour)</td></tr>
</table>

(For students admitted from 2023- 2024)

External Examination question paper)	
Recommended Text	A Textbook of Graph Theory, R. Balakrishnan and K. Ranganathan, Springer, New Delhi.
Reference Books	1. J.A.Bondy and U. S.R.Murty, Graph Theory with Applications, Springer (2002). 2. V. K.Balakrishnan, Theory and Problems of Graph Theory, Schaum's outlines series ,McGra Hill , New Delhi.

Course Outcomes:

Students will be able to

CO1: remember the knowledge of operations on graphs and connectivity.

CO2: understand the knowledge of Connectivity in graphs.

CO3: analyze sound knowledge about Trees, Eulerian and Hamiltonian Graphs.

CO4: analyze the Independent sets and Matchings.

CO5: evaluate the Planar and Nonplanar graphs.

MappingofCOswithPOsandPSOs :

CO-1	3	2	3	3	2	2	3	2	3	2	2.5
CO-2	2	3	3	3	2	3	2	2	3	2	2.5
CO-3	3	2	3	2	2	3	2	3	3	2	2.5
CO-4	3	2	2	3	2	2	3	2	2	3	2.4
CO-5	3	3	2	2	3	3	2	3	2	3	2.6

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">OPTIMIZATION TECHNIQUES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">EC 2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC</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">TPMAECB</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">-</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To create an engineering design methodology using a mathematical formulation of a design problem to support selection of the optimal design among alternatives.</td></tr>
<tr><td colspan="2">Course outline</td><td colspan="8">Unit – I: Duality in linear programming – Introduction – General prime –dual pair –Formulating a dual problem – primal – dual pair in matrix form – Duality theorems – Complementary slackness theorem – Duality and Simplex method.
Chapter 5 (Sec.5.1 – 5.7)</td></tr>
<tr><td colspan="2"></td><td colspan="8">Unit – II: Games and strategies – Introduction – Two – Person Zero – sum Games – Some basic terms – The Maximin – Minimax principle – Games without saddle points – Mixed strategies – Graphic solution 2 x n and m x 2 Games – Dominance property – Arithmetic method for n x n Games – General solution of m x n regular Games.
Chapter 17 (Sec 17.1 – 17.9)</td></tr>
<tr><td colspan="2"></td><td colspan="8">Unit – III: Inventory control – Introduction – The inventory decisions – Cost associated with inventories – Factors affecting inventory control – Economic order quantity[EOQ]- Deterministic inventory problems with no shortage – Deterministic inventory problem with shortage.
Chapter 19 (Sec 19.1 – 19.7)</td></tr>
<tr><td colspan="2"></td><td colspan="8">Unit – IV:EOQ problem with price break – Multi – item deterministic problems- Inventory problems with uncertain demand – Systems of inventory control – Probabilistic inventory problem.
Chapter 19 (Sec 19.8 – 19.12)</td></tr>
<tr><td colspan="2"></td><td colspan="8">Unit – V:Queueing theory – Introduction – Queueing system – Elements of a Queueing system – Operating characteristic of queueing system – Probability distribution in queueing system – Classification of queueing models – Definition of Transient and steady states – Poisson queueing systems.
Chapter 20 (Sec 20.1 – 20.8)</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">Operations Research by Kanti Swarup, P K .Gupta and Manmohan –Sultan chand & sons Educational publishers New Delhi.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="8">1.Kamdy A. Taha, Operations Research, Macmillan Publishing Company, 4th Edition.
2.Prem Kumar Gupta and D.S. Hira, Operations Research: An Introduction, S. Chand & Company Ltd, New Delhi (2004).</td></tr>
</table>

(For students admitted from 2023- 2024)

Course Outcomes:

Students will be able to

- Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.
- Ability to go in research by applying optimization techniques in problems of engineering and technology.
- Ability to solve the mathematical results and numerical techniques of optimization theory to concrete engineering problems by using computer software.

Mapping of COs with POs and PSOs

CO-1	3	2	3	3	2	2	3	2	3	2	2.5
CO-2	2	3	3	3	2	3	2	2	3	2	2.5
CO-3	3	2	3	2	2	3	2	3	3	2	2.5
CO-4	3	2	2	3	2	2	3	2	2	3	2.4
CO-5	3	3	2	2	3	3	2	3	2	3	2.6

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<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 4</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">T2PMAC4</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours/ per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Algebraic Structures</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I:Extension fields.

Chapter 5: Section 5.1</td></tr>
<tr><td colspan="6">UNIT-II: Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5</td></tr>
<tr><td colspan="6">UNIT-III: Elements of Galois theory.

Chapter 5 : Section 5.6</td></tr>
<tr><td colspan="6">UNIT-IV: Finite fields - Wedderburn's theorem on finite division rings.

Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)</td></tr>
<tr><td colspan="6">UNIT-V:A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.

Chapter 7 : Sections 7.3 and 7.4</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved

(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">I.N. Herstein. Topics in Algebra (II Edition) Wiley EasternLimited, New Delhi, 1975.</td></tr>
</table>

(For students admitted from 2023- 2024)

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.
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

MappingofCOswithPOsandPSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<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 5</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">T2PMAC5</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="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="3">Course Outline</td><td colspan="6">UNIT-I :Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability

Chapter - 2 Sec 2.1 to 2.5 (de Barra)</td></tr>
<tr><td colspan="6">UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals

Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)</td></tr>
<tr><td 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 Theorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem

Chapter 11 : Sections 11.1 to 11.15 (Apostol)</td></tr>
</table>

(For students admitted from 2023- 2024)

	UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1 **Chapter 12 : Section 12.1 to 12.14 (Apostol)**
	UNIT-V : Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions. **Chapter 13 : Sections 13.1 to 13.7 (Apostol)**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II) 2. Tom M.Apostol :*Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

(For students admitted from 2023- 2024)

Reference Books	1. Burkill,J.C.*TheLebesgue 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.
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.

MappingofCOswithPOsandPSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<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 6</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">T2PMAC6</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">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="3">Course Outline</td><td colspan="6">UNIT-I :Mathematical Models and Classification of second order equation : Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution

Chapter 2 : Sections 2.1 to 2.6

Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5)</td></tr>
<tr><td colspan="6">UNIT-II :Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.

Chapter 4 : Sections 4.1 to 4.11</td></tr>
<tr><td colspan="6">UNIT-III :Method of separation of variables: Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem- Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations

Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7)</td></tr>
</table>

(For students admitted from 2023- 2024)

	UNIT-IV : Boundary Value Problems : Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle. **Chapter 8 : Sections 8.1 to 8.9**
	UNIT-V : Green's Function: The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem. **Chapter 10 : Section 10.1 to 10.9**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	TynMyint-U and LokenathDebnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987.
Reference Books	1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964. 2. I.N.Sneddon, *Elements of Partial Differential Equations,* McGraw Hill, New Delhi, 1983. 3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems,* McGraw Hill, New York, 1968. 4. M.D.Raisinghania, *Advanced Differential Equations*,S.Chand& Company Ltd., New Delhi, 2001. 5. S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

(For students admitted from 2023- 2024)

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: Toanalyse 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 solveDirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem

MappingofCOswithPOsandPSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)
Part B:5 x 5 = 25 (Either / Or type – One question from each unit)
Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROGRAMMING IN C++ AND NUMERICAL METHODS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">EC 3</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC</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">TPMAECC</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Knowledge of Numerical Methods and C Language</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Train the students to develop analytical thinking and the study of stabilityanalysis. Provide the knowledge of C++ language and enable the students to write object oriented,platform independent and interactive program.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I: Transcendental and Polynomial Equations: Rate of convergence – Polynomial equations: Descartes' Rule of Signs - Iterative Methods: Birge-Vieta method - Bairstow's method.

UNIT- I Chapter 2: Section 2.5 & 2.9[1]

Unit II: Interpolation and Approximation: Hermite Interpolations, Piecewise and Spline Interpolation - Bivariate Interpolation.

UNIT- II Chapter 4: Section 4.5 – 4.7[1]</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit III: Principles ofObject-OrientedProgramming: Software Crisis-Software Evolution- A Look at ProcedureOriented Programming-Object- Oriented Programming Paradigm-BasicconceptsofObjectOrientedProgramming-

Benefits of OOP- ObjectOriented Languages – Application of OOP. Beginning with C++: What is C++ - Applications of C++ - A Simple C++ Program – More C++ Statements – An Example with Class – Structure of C++ Program – Creating the Source File – Compiling and Linking.

UNIT- III Chapter 1: Section 1.1 – 1.8[2] Chapter 2: Section 2.1 – 2.8[2]</td></tr>
</table>

(For students admitted from 2023- 2024)

	Unit IV: FunctionsinC++: Introduction – TheMainFunction– Functionprototyping – Call by Reference – Return by Reference – Inline functions– Default Arguments – const Arguments – Recursion - Function overloading. **UNIT- IV Chapter 4: Section 4.1 – 4.10[2]** Unit V: Classes and Objects: Introduction – C structures Revisited - Specifying a Class– Defining Member Functions – C++ Program with Class – Making an Outside Function Inline – Nesting of Member Functions – Private Member Functions – Arrays within a Class – Memory allocation for Objects- Static Data Members – Static Member Functions–Arrays of Objects – Objects as Function Arguments – Friendly Functions – Returning Objects – const Member Functions **UNIT- V Chapter 5: Section 5.1 – 5.17[2]**
Recommended Text	1. M.K. Jain, S.R.K. Iyengar and R.K. Jain (2022), Numerical Methods for Scientific and Engineering Computation, New Age International (P) Limited Publishers, New Delhi, 8th Edition. 2. E. Balagurusamy (2018), Object-OrientedProgramming with C++, TataMcGrawHill,7thEdition
Reference Books	**1.** M.K. Jain (1983), Numerical Solution of Differential Equations, New Age International Pvt Ltd., 2nd Edition, 2. RobertLafore (2019), Object OrientedProgrammingin C++, PearsonEducation, 4th Edition. 3. RajeshK.Shukla (2009), Object OrientedProgrammingin C++, Wilsey India Pvt. Ltd, 1st Edition.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CO1Implement numerical methods in computer programming using C++ language.

CO2 Classify the various techniques of interpolation and approximation and design different numerical algorithms with respect to accuracy and efficiency of solution.

CO3:Explain and measure errors in numerical computations and outline the basic concepts of Oops,classes, objects and functions.

CO4 Compute solutions of interpolation problems and exhibit the knowledge of program execution and debugging of C++.

CO5 Apply various methods to solve transcendental and polynomial equations and Illustrate the components of C++programming.

(For students admitted from 2023- 2024)

MappingofCOswithPOsandPSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROGRAMMING IN C++ AND NUMERICAL METHODS – PRACTICAL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">EC 4</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC</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">TPMAECD</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2"></td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6"></td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6"></td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6"></td></tr>
</table>

(For students admitted from 2023- 2024)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Introduction to LATEX and SageMath</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">T2PMAS1</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 colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td>1</td><td colspan="2">--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I : LATEX: Introduction – Simple typesetting – Fonts – Type size – The document –Page style – page numbering – Formatting length – Parts of a document – Dividing the document – Bibliography.
Tutorial I and II and Tutorial III (Section 1)
UNIT II: Typesetting Mathematics – Basics – Custom commands – More on Mathematics –Mathematics miscellany.
Tutorial VIII (Section: 4.1 -4.2)
UNIT III : Delimiters – Putting one over another -Typesetting theorems – Theorems typing in Latex – Designer theorems-The amsthm package.
Tutorial VIII (Section :4.3-4.4) &
Tutorial IX (Section : 9.1 -9. 2)
UNIT IV : Introduction – SageMath – Sage commands – Algebra – Functions – Graphs, Limits and Continuity of Functions.
(Chapter 1.1, 1.2.3-1.4 & Chapter 2.1, 2.2-2.3) Omitted (2.1.2)
Unit V: Differentiation – The derivative – Higher order derivative – Chain Rule and Implicit Differentiation – Derivatives of Inverse, Exponential and Logarithmic Functions – Integration – Antiderivatives – Riemann Sums and the Definite Integral – The fundamental theorem of calculus.
(Chapter 3 (full) & Chapter 5: 5.1-5.3)</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1.LATEX Tutorials, A PRIMER Indian TEX Users Group, Trivandrum, India (2003).</td></tr>
</table>

(For students admitted from 2023- 2024)

Course Outcomes:

Students will be able to

CO1:apply the knowledge to learn and create Latex file.

CO2:analyze the Latex commands to large files.

CO3:evaluate mathematical derivations and structures using Latex

CO4: understand SageMath techniques, Symbolic Expressions and Simplification and solve problems in analysis.

CO5: Expertise in the basic programming structures and its algorithms.

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<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 7</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">T3PMAC7</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">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 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" rowspan="3">Course Outline</td><td colspan="6">UNIT-I : Cauchy’s Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions:
Removable Singularities-Taylors’s Theorem – Zeros and poles – The local Mapping – The Maximum Principle.
Chapter 4 : Section 2 : 2.1 to 2.3
Chapter 4 : Section 3 : 3.1 to 3.4</td></tr>
<tr><td colspan="6">UNIT-II :The general form of Cauchy’s Theorem : Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy’s Theorem - Proof of Cauchy’s theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7
Chapter 4 : Section 5: 5.1 and 5.2</td></tr>
<tr><td colspan="6">UNIT-III :Evaluation of Definite Integrals and Harmonic Functions Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.
Chapter 4 : Section 5 : 5.3
Chapter 4 : Sections 6 : 6.1 to 6.3</td></tr>
</table>

(For students admitted from 2023- 2024)

	UNIT-IV :Harmonic Functions and Power Series Expansions: Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series . **Chapter 4 : Sections 6.4 and 6.5** **Chapter 5 : Sections 1.1 to 1.3**
	UNIT-V: Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem **Chapter 5 : Sections 2.1 to 2.4** **Chapter 5 : Sections 3.1 and 3.2**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Lars V. Ahlfors, *Complex Analysis*, (3^{rd} edition) McGraw Hill Co., New York, 1979
Reference Books	1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990. 2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978 3. E. Hille, *Analytic function Thorey* (2 vols.), Gonm& Co, 1959. 4. M.Heins, *Complex function Theory*, Academic Press, New York,1968.
Website and **e-Learning Source**	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

(For students admitted from 2023- 2024)

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

CLO4: Develop Taylor and Laurent series .

CLO5 Explain the infinite products, canonical products and jensen's formula .

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROBABILITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE 8</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">T3PMAC8</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">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT-I : Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.
Chapter 1: Sections 1.1 to 1.7

Chapter 2 : Sections 2.1 to 2.9</td></tr>
<tr><td colspan="6">UNIT-II : Parameters of the Distribution : Expectation-Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.
Chapter 3 : Sections 3.1 to 3.8</td></tr>
<tr><td colspan="6">UNIT-III: Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.
Chapter 4 : Sections 4.1 to 4.7</td></tr>
<tr><td colspan="6">UNIT-IV : Some Probability distributions: One point , two point , Binomial – Polya – Hyper geometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.
Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)</td></tr>
</table>

(For students admitted from 2023- 2024)

	UNIT-V: Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers. **Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.
Reference Books	1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972 2. K.L.Chung, A course in Probability, Academic Press, New York, 1974. 3. R.Durrett, Probability : Theory and Examples, (2^{nd} Edition) Duxbury Press, New York, 1996. 4. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://www.probability.net

(For students admitted from 2023- 2024)

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.

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<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 9</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">T3PMAC9</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">5</td><td colspan="2">1</td><td>--</td><td>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">UNIT-I : Topological spaces : Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points.

Chapter 2 : Sections 12 to 17</td></tr>
<tr><td colspan="6">UNIT-II :Continuous functions: Continuous functions – the product topology – The metric topology.

Chapter 2 : Sections 18 to 21 (Omit Section 22)</td></tr>
<tr><td colspan="6">UNIT-III :Connectedness: Connected spaces- connected subspaces of the Real line – Components and local connectedness.

Chapter 3 : Sections 23 to 25.</td></tr>
<tr><td colspan="6">UNIT-IV : Compactness : Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.
Chapter 3 : Sections 26 to 29.</td></tr>
<tr><td colspan="6">UNIT-V: Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz extension theorem.
Chapter 4 : Sections 30 to 35.</td></tr>
</table>

(For students admitted from 2023- 2024)

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	James R. Munkres, *Topology* (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)
Reference Books	1. J. Dugundji ,*Topology* , Prentice Hall of India, New Delhi, 1975. 2. George F.Sinmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Book Co., 1963 3. J.L. Kelly, *General Topology*, Van Nostrand, Reinhold Co., New York 4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970. 5. S.Willard, *General Topology*, Addison - Wesley, Mass., 1970
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

(For students admitted from 2023- 2024)

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

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROGRAMMING IN PYTHON</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE 10</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">T3PMAC10</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours ,per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="2">--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To Understand fundamental programming concepts of Python programming
2. To study basic programming concepts and packages for data analysis,.
3. To study about structure and LOOP
4. To gain inputs in Data structure, plotting & visualisation</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT-I : Introduction to Python - Features of Python - Identifiers - Reserved Keywords - Variables Comments in Python – Input , Output and Import Functions – Operators Data Types and Operations – int, float, complex, Strings, List, Tuple, Set, Dictionary - Mutable and Immutable Objects – Data Type Conversion t

Unit I: Chapter 1 & 2</td></tr>
<tr><td colspan="6">UNIT-II : Flow Control - conditional (if), alternative (if-else), if-else if.-else, nested if - Loops for, while, break, continue, pass; Functions: Functions, Modules and Exception Handling Functions Definition, Function Calling, Function Arguments (Required, Keyword, Default), Recursion

Unit II: Chapter 3 – 3.1 to 3.4 and Chapter 4</td></tr>
<tr><td colspan="6">UNIT-III : Built-in Modules - Creating Modules - Import statement - Locating modules - Namespaces and Scope - Packages in Python File Handling : Opening, Closing, Writing, Reading and deleting Exceptions Handling: Built-in Exceptions Exception handling, Exception with arguments, Raising an Exception - User defined Exceptions - Assertions in Python

Unit III: Chapter 5 – 5.1 -5.5. & 5.8; Chapter 6 – 6.1 to 6.7 and Chapter 8.</td></tr>
<tr><td colspan="6">UNIT-IV : Object Oriented Programming: Class Definition, Object Creation, Built-in Attribute Methods, Encapsulation, Data Hiding, Inheritance, Multi-Level Inheritance, Polymorphism (Method Overriding, Operator Overloading)
Unit IV: Chapter 7</td></tr>
</table>

(For students admitted from 2023- 2024)

	UNIT-V: GUI Programming :Introduction – Tkinter Widgets – Label – Message Widget – Entry Widget – Text Widget – tk Message Box – Button Widget – Radio Button- Check Button – List box Frames _ Top-level Widgets – Menu Widget **Unit V**: Chapter 12- 12.1, 12.2 – 12.2.1 to 12.2.12
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Taming Python By Programming, Dr. Jeeva Jose, Khanna Publishing, 2019.
Reference Books	1. Introduction to Problem solving using Python - E.Balagurusamy – TMH – First Edition - 2015 2. ChSatyanarayana, M Radhika Mani, BN Jagadesh - Python Programming- Cengage, New Delhi.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1:Demonstrate the understanding of basic programming terminologies and packages of python language.

CLO 2:Will gain knowledge on concepts and packages for data analysis, modelling, and visualization in python language.

CLO 3:In depth understanding about structure and LOOP

CLO 4 ;In depth Understanding about OOP

CLO 5:gain inputs in GUI programming

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROGRAMMING IN PYTHON - PRACTICAL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">EC 5</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC</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">TPMAECE</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">3</td><td colspan="2"></td><td>--</td><td>3</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To Understand fundamental programming concepts of Python programming
2. To study basic programming concepts and packages for data analysis,.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">1. Write a Python program to find the value of Triple Integral
2. Write a python program to find the solution of simultaneous linear equations.
3. Write a Python program to find the nth derivatives.
4. Python program to find nth derivative with and without Leibnitz rule.
5. Write a python program to solve partial differential equations.
6. Write a program to input and multiply two matrices
7. Write a program to compute Eigen value and Eigen vector of a given 3X3 matrix using Numpy
8. Write a python program to determine the intersection point of two lines.
9. Create a program that performs the Fourier transform of a given function. You can use the FFT algorithm to implement this.
10. Create a program that visualizes mathematical functions and data using the Matplotlib library. The program should be able to create line plots, scatter plots, bar charts, and other types of visualizations</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">S. A. Choudum, A First course in Graph Theory, Macmillan Publishers India Pvt Ltd, 2000.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. F. Harary, Graph Theory, Narosa Publishing Company, 2001.
2. NarsinghDeo, Graph Theory with applications to Engineering & Computer Science, Prentice Hall of India ,New Delhi, 1997.</td></tr>
</table>

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Research Tools And Techniques</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">T3PMAS2</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>2</td><td>1</td><td>--</td><td colspan="3">3</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Objectives of the Course :

This course is to help researchers and students of the science in our discipline to prepare manuscripts that will have a high probability of being accepted for publication and of being completely understood when they are published.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Research Process- Research Design

Chapter 2 and chapter 3</td></tr>
<tr><td colspan="6">UNIT-II :Research Problem-Variables and Their Types

Chapter 4 and chapter 5</td></tr>
<tr><td colspan="6">UNIT-III : Formulation of Hypothesis– Sampling- Tools of Data Collection

Chapter 6,7 and Chapter 8</td></tr>
<tr><td colspan="6">UNIT-IV : Data Analysis- Interpretation of Data
Chapter 9 and chapter 10</td></tr>
<tr><td colspan="6">UNIT-V: Research Methods - Descriptive or Survey Method - Experimental Method
Chapter 11,12 and chapter 13</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1.RESEARCH METHODOLOGY: TOOLS AND TECHNIQUES Dr. Prabhat Pandey Dr. Meenu Mishra Pandey © Bridge Center, 2015</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Ackoff, Russell L. (1961). The Design of Social Research, University of Chicago Press: Chicago. 2. Allen, T. Harrell, (1978). New Methods in Social Research, Praeger Publication: New York.</td></tr>
</table>

(For students admitted from 2023- 2024)

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

CO1: Make use of variety of Teaching - learning strategies, Instructional Designs in higher education.
CO2: Apply the domain knowledge of teaching and technology in Lecture, Seminar, Symposium, Panel Discussion,
CO3: Understand the Team Teaching, Project and workshop.
CO4: Evaluate identify the effective teaching methods for classroom management.
CO5: Demonstrate pursuit of knowledge as a character formation and interpersonal skills.

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A : $5 \times 15 = 75$

(Five out of Eight – Must one question from each unit)

(For students admitted from 2023- 2024)

<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 11</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">T4PMAC11</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">UNIT-I :Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem .
Chapter 9:Sections 46-48</td></tr>
<tr><td colspan="6">UNIT – II: The natural imbedding of N in N^{**}- The open mapping theorem – The conjugate of an Operator.
Chapter 9:Sections 49-51</td></tr>
<tr><td colspan="6">UNIT-III :Hilbert Spaces: The definition and some simple properties– Orthogonal complements–Ortho normal sets–The conjugate space H^*.
Chapter10:Sections 52-55</td></tr>
<tr><td colspan="6">UNIT-IV : The adjoint of an operator–self-adjoint operators-Normal and unitary operators – Projections.
Chapter 11:Sections 56-59</td></tr>
<tr><td colspan="6">UNIT-V : Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator –The spectral theorem.
Chapter 12:Sections 60-63</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>

(For students admitted from 2023- 2024)

Recommended Text	G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited, New Delhi, 1963.
Reference Books	1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973. 2. B.V. Limaye, Functional Analysis, New Age International,1996. 3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987. 4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978. 5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://en.wikiepedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

CLO2: Prove Hahn Banach theorem and open mapping theorem.

CLO3: Describe operators and fundamental theorems.

CLO4: Validate orthogonal and orthonormal sets.

CLO5: Analyze and establish the regular and singular elements.

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<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 12</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">T4PMAC12</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Linear Algebra concepts and Calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surface and the differential geometry of surfaces are explored</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Space curves: Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.

Chapter I : Sections 1 to 9.</td></tr>
<tr><td colspan="6">UNIT-II :Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.

Chapter II: Sections 1 to 9.</td></tr>
<tr><td colspan="6">UNIT-III : Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems

Chapter II: Sections 10 to 13.</td></tr>
<tr><td colspan="6">Unit IV

Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.

Chapter II: Sections 14 to 18.</td></tr>
<tr><td colspan="6">UNIT-V : Non Intrinsic properties of a surface:
The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface.

Chapter III: Sections 1 to 6.</td></tr>
</table>

(For students admitted from 2023- 2024)

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	T.J.Willmore, *An Introduction to Differential Geometry*, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print)
RefereEce Books	1. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950. 2. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry*, Inter science Publishers, 1963. 3. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978. 4. J.A. Thorpe *Elementary topics in Differential Geometry*, Under-graduate Texts in Mathematics, Springer - 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

(For students admitted from 2023- 2024)

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

Part A:10 x 2 = 20 (Two Questions from each unit)

Part B:5 x 5 = 25 (Either / Or type – One question from each unit)

Part C:3 x 10 = 30 (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<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">EC6</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EC</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">TPMAECF</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To study the basic concept from the theory of Markov chain and their properties.
2. To study the states in Markov chain in discrete state
3. To understand the concepts of Renewal Process , Theorems and Equations
4 To learn more about several queuing models with time series and their performance Measures.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Stochastic processes: Some notions - Introduction- Specification of stochastic processes – stationary processes – Mortingales – Difference equation: Differentiable- Difference equations. Markov chain -Definition and examples – High transition probabilities.
Chapter 2(Sec 2.1-2.4), & Chapter 3(Sec 3.1,3.2)</td></tr>
<tr><td colspan="6">UNIT-II : Generalization of independent Bernoulli trails: sequence of chain dependent trails – Classification of states and chain: Determination of higher transition probabilities – Stability of Markov system – Graph theoretic approach – Markov chain with denumerable number of states.

Chapter 3 (Sec 3.3 - 3.8)</td></tr>
<tr><td colspan="6">UNIT-III : Markov processes with discrete state space: Poisson process and its extensions: Poisson process – Poisson process and related distributions – Generalizations of Poisson process – Birth death process.
Chapter 4 (Sec 4.1 - 4.4)</td></tr>
<tr><td colspan="6">UNIT-IV :Renewal Processes and Theory -Renewal Process-Renewal Processes in Continuous Time-Renewal Equation- Stopping Time: Wald's Equation- Renewal Theorems
Chapter 6 (Sec : 6.1 - 6.5)</td></tr>
<tr><td colspan="6">UNIT-V : Stochastic Processes in Queuing system: General concepts – The queuing model M/M/1 : Steady state behavior. Transient behavior of M/M/1 model – Birth and death processes - The model M/M/S.

Chapter 10 (Sec 10.1 - 10.3, 10.4 (only 10.4.1, 10.4.2, 10.4.2.1))</td></tr>
</table>

(For students admitted from 2023- 2024)

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)
Recommended Text	Scope and Treatment as in Stochastic Processes, J.Medhi, Wiley Eastern Limited.
Refereece Books	1. A First course in Stochastic Process, S.Kqrlin and M.Taylor, Second Edition, Academic Press, Newyork (1975). 2. Elements of Applied Stochastic processes, U, N. Bhrt, 2nd edition, Wiley, New York (1968)

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CO1: Understand the deviations involving conditional probability distributions and conditional expectations.

CO2: Classify the classes of states in Markov chain and characterize the class.

CO3:To solve the derivation of the differential equations for time continuous Markov processes with discrete state space.

CO4: Understand the Renewal processes.

CO5: Using the queuing theory models of time series in Statistics.

Mapping of Cos with Pos and PSOs :

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

Question Paper Pattern

Maximum Marks: 75 Examination Duration: 3 Hours

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Part B : $5 \times 5 = 25$ (Either / Or type – One question from each unit)

Part C : $3 \times 10 = 30$ (Three out of Five - One question from each unit)

(For students admitted from 2023- 2024)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">GENERAL STUDIES FOR TNPSC/UPSC</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">PCS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">PCS</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">T4PMAS3</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The purpose of general studies is to help students develop a wide range of skills, including critical thinking, problem solving, communication and creativity that are valuable in many different carrer paths and life situations</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT I GENERAL SCIENCE

Measurement of physical quantity – General scientific Laws inMotion – Basic principles of Mechanics – Electicity – Magnetism – Light ,sound,heat and Nuclear Physics in our daily life – Elements and Compounds Food Adulterants – Classification of organisms – Evolution – Genetics – Health and Hygiene.

UNIT II CURRENT EVENTS

Latest Diary of Events – National symbols Profile of states – Eminent personalities and places in news – Books and Authors.

UNIT III GEOGRAPHY

Earth Location – Monsoon – Rainfall – Weather and climate – Water resources – Rivers – Soil – Minerals – Agriculture – Transport – Communication.

UNIT IV HISTORY

Characteristics of Indian culture – Unity in Diversity – Race – Language – custom - National Renaissance – Indian National Congress - Emergence of Leaders – B.R. Ambedkar – Mahatma Gandhi – Jawarharlal Nehru – Thanthai Periyar – Bharathiyar – Muthulakshmi Ammaiyar – Muvalur Ramamirtham.

UNIT V INDIAN POLITY

Constitution of India – Preamble to the constitution - salient features of the constitution – Union,State and Territority – citizenship – Fundamental Rights and duties</td></tr>
</table>

(For students admitted from 2023- 2024)

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Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	**General Studies Reference For Ug Level Syllabus**

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CO1: Understanding the general laws and applying in day to day life.

CO2: Acquiring knowledge in current affairs.

CO3: Develop an idea about concept of earths tectonic and resultant landforms.

CO4: Gather knowledge about the society, culture , religion and political history.

CO5: Provides learners with knowledge and skills needed to prepare for a professional carrer as a teacher, administrator, political scientists, lawyers.

Mapping of Cos with Pos and PSOs :

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

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