Holy Cross College (Autonomous), Nagercoil - 629004

Kanyakumari District, Tamil Nadu.

Nationally Accredited with A^+ by NAAC IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF MATHEMATICS

TEACHING PLAN (PG)

EVEN SEMESTER 2024-2025

Vision

To empower women globally competent with human values and ethics acquiring academic and entrepreneurship skills through holistic education.

Mission

1. To create opportunities which will ensure academic excellence in critical thinking, humanistic and scientific inquiry.
2. To develop application-oriented courses with the necessary input of values.
3. To create a possible environment for innovation, team spirit and entrepreneurial leadership.
4. To form young women of competence, commitment and compassion.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	Upon completion of M. Sc. Degree Programme, the graduates will be able to:	Mapping with Mission
PEO1	apply scientific and computational technology to solve social and ecological issues and pursue research.	**M1, M2**
PEO2	continue to learn and advance their career in industry both in private and public sectors.	**M4 & M5**
PEO3	develop leadership, teamwork, and professional abilities to become a more cultured and civilized person and to tackle the challenges in serving the country.	**M2, M5 & M6**

PROGRAMME OUTCOMES (POs)

POs	Upon completion of M.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	apply their knowledge, analyze complex problems, think independently, formulate and perform quality research.	**PEO1 & PEO2**
PO2	carry out internship programmes and research projects to develop scientific and innovative ideas through effective communication.	**PEO1, PEO2 & PEO3**
PO3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe.	**PEO2**
PO4	develop innovative initiatives to sustain eco friendly environment	**PEO1, PEO2**
PO5	through active career, team work and using managerial skills guide people to the right destination in a smooth and efficient way.	**PEO2**
PO6	employ appropriate analysis tools and ICT in a range of learning scenarios, demonstrating the capacity to find, assess, and apply relevant information sources.	**PEO1, PEO2 & PEO3**
PO7	learn independently for lifelong executing professional, social and ethical responsibilities leading to sustainable development.	**PEO3**

PROGRAMMESPECIFICOUTCOMES(PSOs)

PSO	Upon completion of M.Sc. Degree Programme, the graduates of Mathematics will be able to:	PO Addressed
PSO–1	acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics	**PO1 & PO2**
PSO–2	understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.	**PO3 & PO5**
PSO–3	prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions	**PO6**
PSO–4	pursue scientific research and develop new findings with global impact using latest technologies.	**PO4 & PO7**
PSO–5	possess leadership, teamwork and professional skills, enabling them to become cultured and civilized individuals capable of effectively overcoming challenges in both private and public sectors.	**PO5 & PO7**

Department : Mathematics

Class : I M.Sc

Semester : II

Name of the Course : Advanced Algebra

Course Code : MP232CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP232CC1	**5**	1	**-**	**-**	**5**	**6**	**90**	**25**	**75**	**100**

Learning Objectives

1. To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals
2. To develop computational skill in abstract algebra.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	Exhibit a foundational understanding of essential concepts, including field extensions, roots of polynomials, Galois Theory, and finite extensions	**K1**
2.	Demonstrate knowledge and understanding of the fundamental concepts including extension fields, Galois Theory, Automorphisms and Finite fields	**K2**
3.	Compose clear and accurate proofs using the concepts of Field extension, Galois Theory and Finite field	**K3**
4.	Examine the relationships between different types of field extensions and their implications by applying algebraic reasoning	**K4**
5.	Evaluate the validity of statements and theorems in field theory by providing proofs or counterexamples	**K5**
6.	Develop novel results or theorems in field theory, potentially by exploring extensions of existing theories	**K6**

Total contact hours: 90 (Including instruction hours, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	Extension Fields					
	1.	Extension Fields, dimension, subfield- Introduction and definition	2	K1 & K2	Brainstorming	MCQ
	2.	Theorems based on extension fields	3	K3	Chalk and Talk	Slip Test using Socrative
	3.	Definition and Theorems on algebraic over a field F	3	K1 & K3	Analytic Method	Questioning
	4.	Theorems on algebraic extension	3	K5	Lecture with Illustration	Questioning
	5.	Interpretation of Extension fields such as finite extension, algebraic extension	1	K4	Collaborative learning	Concept explanations
	6.	Transcendence of e	3	K2, K3 & K5	Blended classroom	Evaluation through poll
II	Roots of Polynomials					
	1.	Definition- roots of polynomials, multiplicity of roots	1	K1	Brainstorming	True/False
	2.	Remainder theorem	1	K3	Flipped Classroom	Short summary of the theorem
	3.	Theorems based on roots of polynomials	2	K2 & K3	Lecture Discussion	Concept definitions
	4.	Existence theorem of splitting fields	2	K3 & K4	Group Discussion	Recall steps

	5.	Theorems based on isomorphism of fields	2	K3	Lecture with Illustration	Questioning
	6.	Theorems based on splitting field of polynomials	2	K3	Blended classroom	MCQ
	7.	Uniqueness theorem of splitting fields	2	K4 & K5	Peer Instruction	Slip Test using Quizziz
	8.	Definition- derivative of polynomials, Simple extension	1	K2 & K3	Flipped Classroom	Quiz
	9.	Theorems on simple extension	2	K5& K6	Integrative method	Evaluation through short test
III	Galois Theory					
	1.	Definition -Fixed Field, Group of automorphism	1	K1 & K2	Brainstorming	Quiz
	2.	Theorems on Fixed Field	2	K3	Lecture	Concept Explanation
	3.	Theorems on Group of Automorphism	3	K4	Lecture Discussion	Slip Test
	4.	Theorems on Normal Extension	2	K5	Lecture	Questioning
	5.	Theorems on Galois Group	3	K6	Collaborative learning	Questioning
	6.	Construct theorems on Normal Extension and Galois Group	4	K6	Poster Presentation	Simple Questions
IV	Finite Fields					
	1.	Definition -Finite Fields, Characteristic of F with examples	3	K1 & K2	Brainstorming	Quiz

	2.	Theorems based on Finite Fields and Characteristic of F	4	K3 & K4	Flipped Classroom	Differentiate between various ideas
	3.	Finite field and Cyclic group	4	K4 & K5	Analytic Method	Simple Questions
	4.	Wedderburn's Theorem on finite division ring	4	K4 & K5	Integrative method	Concept Explain
V	Solvability by Radicals					
	1.	Solvability by radicals - Introduction	1	K1 & K2	Seminar Presentation	MCQ
	2.	Solvable and Commutator group	1	K4	Seminar Presentation	Concept explanations
	3.	Lemma and Theorem based on solvable by radicals	1	K4 & K5	Seminar Presentation	Questioning
	4.	General polynomial definition and theorem	2	K2 & K3	Seminar Presentation	Slip Test
	5.	Definitions -algebraic over F and Frobenius theorem	4	K2 & K5	Seminar Presentation	Simple Questions
	6.	Internal quaternions and Lagrange identity	2	K4	Seminar Presentation	Evaluation through short test
	7.	Left-Division algorithm	3	K6	Seminar Presentation	Simple Questions
	8.	Four-Square Theorem	3	K6	Seminar Presentation	Simple Questions

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**

Activities (Em/ En/SD): **Poster Presentation, Develop Theorems on Extension Fields**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Make an interactive PPT (Any topic from the syllabus)**

Seminar Topic: **Unit V**

Sample questions

Part A

1. Complete: [L:F] =----------
   a) [L:K]+ [K:F] b) [L:K]-[K:F] c) [L:K][K:F] d) [L:K]/[K:F]
2. Complete: Any polynomial of degree n over a field can have ---------- roots in any extension field.
   a) exactly n b) at least n c) at most n d) exactly n+1
3. What is the Galois group of x^3 -3x -3 over Q ?
4. Say True or False: $\Phi_3(x) = x^2 + x + 1$ is a cyclotomic polynomial
5. Say True or False: The adjoint in Q satisfies $x^{**} = x$

Part B

1. Prove that F(a) is the smallest subfield of K containing both F and a
2. State and prove Remainder theorem
3. If K is a finite Extension of F ,then G(K,F) is a finite group then prove that o(G(K,F)) ≤ [K:F]
4. Analyse: For every prime number p and every positive integer m there is a unique field having p^m elements
5. State and prove Lagrange Identity.

Part C

1. Prove that the element a ∈ K is algebraic over F if and only if F(a) is a finite extension of F
2. Justify: A polynomial of degree n over a field can have at most n roots in any extension field
3. State and prove fundamental theorem of Galois theory
4. Prove that, the multiplicative group of nonzero elements of a finite field is cyclic.
5. Justify: Every positive integer can be expressed as the sum of squares of four integers.

Head of the Department Course Instructor

Dr. T. Sheeba Helen Dr. S.Sujitha

Department : Mathematics

Class : I M.Sc

Semester : II

Name of the Course : Core Course V: Real Analysis – II

Course Code : MP242CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP242CC2	**5**	1	-	-	**5**	**6**	**90**	**25**	**75**	**100**

Learning Objectives

1. To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals.
2. To get the in-depth study in multivariable calculus.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the basic concepts of measurable sets, measurable function, integration of functions, Fourier series on real line and multivariable differential calculus, implicit functions and extremum problems.	**K1**
2.	describe the elementary facts of Lebesgue measure, Lebesgue integral, Fourier series and multivariable differential calculus; understand the implicit functions and extremun problems.	**K2**
3.	determine the measurable sets, measurable functions, the matrix representation and Jacobian determinant of functions.	**K3**
4.	analyze the properties of measurable functions, Riemann and Lebesgue integrals, convergence of Fourier series and extrema of real valued functions.	**K4**
5.	test measurable sets and measurable functions.	**K5**

Total contact hours: 90 (Including instruction hours, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Lebesgue Measure**					
	1.	Introduction Outer Measure	3	K1	Brain storming	Questioning
	2.	Measurable sets and Lebesgue measure	4	K2 & K5	Context based	Quiz through Quizziz
	3.	A non measurable set	2	K3	Interactive Teaching	Student Presentation
	4.	Measurable Functions	4	K2 &K5	Lecture with Illustration	Oral Test
	5.	Littlewood's three principles	2	K2	Collaborative learning	Concept explanations
II	**The Lebesgue Integral**					
	1.	The Riemann Integral	5	K1 & K2	Brainstorming	Quiz through Slido
	2.	The Lebesgue integral of a bounded function over a set of finite measure	5	K3	Flipped Classroom and Seminar Presentation	Home Work
	3.	The integral of a nonnegative function	3	K2	Blended Learning	Assignment
	4.	The general Lebesgue integral	2	K4	Lecture & Seminar presentation	Oral presentation

III	**Fourier Series and Fourier Integrals**					
	1.	Orthogonal system of functions - The theorem on best approximation	3	K1 & K2	Brainstorming	Quiz through Socrative
	2.	The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients	2	K4	Lecture	Questioning
	3.	The Riesz-Fischer Thorem - The convergence and representation problems for trigonometric series - The Riemann - Lebesgue Lemma	4	K3	Content Based	Concept Explanation
	4.	The Dirichlet Integrals - An integral representation for the partial sums of Fourier series	4	K4	Flipped Class Room & Seminar Presentation	Slip Test
	5.	Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point	4	K4	Lecture	Home Work
	6.	Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem	3	K4	Collaborative learning	Recall Concepts
IV	**Multivariable Differential Calculus**					
	1.	The Directional derivative - Directional derivative and continuity	4	K1 & K2	Brainstorming	Quiz through Quizziz

	2.	The total derivative - The total derivative expressed in terms of partial derivatives-	4	K2 & K3	Flipped Classroom	Differentiate between various ideas
	3.	The matrix of linear function - The Jacobian matrix	2	K3	Illustrative Method	Simple Questions
	4.	The chain rule - Matrix form of chain rule	3	K2 & K3	Lecture Method	Concept Explain
	5.	The mean - value theorem for differentiable functions - A sufficient condition for differentiability	3	K4	Content Based	Home Work
	6.	A sufficient condition for equality of mixed partial derivatives	2	K4	Lecture Method	Slip Test
	7.	Taylor's theorem for functions of R^n to R^1	2	K4	Content Based	Short Answer Test
V	**Implicit Functions and Extremum Problems**					
	1.	Functions with non-zero Jacobian determinants	4	K2 & K3	Content Based	Questioning
	2.	The inverse function theorem	3	K3	Analytic Method	Concept explanations
	3.	The Implicit function theorem-	3	K3	Lecture Method	Questioning
	4.	Extrema of real valued functions of severable variables	5	K2 & K4	Content Based and Seminar Presentation	Home Work
	4.	Extremum problems with side conditions.	5	K4	Lecture Method	Slip Test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**

Activities (Em/ En/SD): **Poster Presentation and Video Making**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Make an interactive PPT using AI (Any topic from the syllabus)**
Seminar Topic**: Problems in the Exercises**

Sample Questions

Part A

1. Which of the following is not measurable set
   (a) Interval (b) Borel set (c) subset of a measurable set
2. $Dirichlet's$ function on [a,b] is . . . . . .
3. A function is said to be periodic with period $\boldsymbol{p \neq 0}$ if . . ..
4. The directional derivative of $\boldsymbol{f}$ at $\boldsymbol{c}$ in the direction $\boldsymbol{u}$ is . . ..
5. Let $\boldsymbol{B = B(a,r)}$ be an n-ball in $\boldsymbol{R^n}$. Then $\boldsymbol{\partial B}$ = ...

Part B

1. Prove that the union of a countable collection of measurable sets is measurable.
2. Let f be a bounded measurable function on a set of finite measure E. Then f is integrable over E.
3. Assume that $\boldsymbol{g(0+)}$ exists and suppose that for some $\boldsymbol{\delta > 0}$ the Lebesgue integral $\int_0^{\delta} \frac{g(t)-g(0+)}{t}\boldsymbol{dt}$ exists. Prove that $\lim_{n\to\infty} \frac{2}{\pi}\int_0^{\delta} \boldsymbol{g(t)}\frac{\sin \alpha t}{t}\boldsymbol{dt} = \boldsymbol{g(0+)}$.
4. Let $\boldsymbol{f = u + iv}$. Show that Cauchy-Riemann equations along with differentiability of u and v, imply that $\boldsymbol{f'(c)}$.
5. Let $\boldsymbol{f}$ be a real – valued function with continuous second –order partial derivatives at a stationary point $\boldsymbol{a}$ in $\boldsymbol{R^2}$. Let $\boldsymbol{A = D_{1,1}f(a), B = D_{1,2}f(a), C = D_{2,2}f(a)}$ and let $\boldsymbol{\Delta = det\begin{bmatrix} A & B \\ B & C \end{bmatrix} = AC - B'}$.

Then prove that a) If $\boldsymbol{\Delta > 0}$ and $\boldsymbol{A > 0, f}$ has a relative minimum at $\boldsymbol{a}$.
b) If $\boldsymbol{\Delta > 0}$ and $\boldsymbol{A < 0, f}$ has a relative maximum at $\boldsymbol{a}$.
c) If $\boldsymbol{\Delta < 0, f}$ has a saddle point at $\boldsymbol{a}$.

Part C

1. Prove that the outer measure of an integral is its length.
2. State and prove Monotone convergence theorem.
3. State and Prove Riesz-Fischer theorem.
4. State and prove mean-valued theorem for vector-valued functions.
5. Assume $\boldsymbol{f = (f_1, f_2, \ldots, f_n) \in C'}$ on an open set in $\boldsymbol{R^n}$, and let $\boldsymbol{T = f(S)}$. If the Jacobian determinant $\boldsymbol{J_r(a) \neq 0}$ for some point $\boldsymbol{a}$ in $\boldsymbol{S}$, then prove that there are two open sets $\boldsymbol{X \subseteq S}$ and $\boldsymbol{Y \subseteq T}$ and a uniquely determined function $\boldsymbol{g}$ such that
   a) $\boldsymbol{a \in X}$ and $\boldsymbol{f(x) \in Y}$,
   b) $\boldsymbol{Y = f(X)}$,
   c) $\boldsymbol{f}$ is one-to-one on $\boldsymbol{X}$,
   d) $\boldsymbol{g}$ is defined on $\boldsymbol{Y}$, $\boldsymbol{g(Y) = X}$ and $\boldsymbol{g\big(f(x)\big) = x}$ for every $\boldsymbol{x}$ in $\boldsymbol{X}$,
   e) $\boldsymbol{g \in C'}$ on $\boldsymbol{Y}$.

Head of the Department
Dr. T. Sheeba Helen

Course Instructor
Dr. M. K. Angel Jebitha

Teaching Plan

Department : Mathematics
Class : I M. Sc Mathematics
Title of the Course : Partial Differential Equation
Semester : II
Course Code : MP232CC3

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP232CC3	5	1	-	-	4	6	90	25	75	100

Objectives

1.To formulate and solve different forms of partial differential equations.
2. Solve the related application-oriented problems.

Course Outcomes

On the successful completion of the course, students will be able to:		PSO Addressed	Cognitive Level
1.	recall the definitions of complete integral, particular integral, and singular integrals.	PSO-2	R
2.	learn some methods to solve the problems of non-linear first-order partial differential equations. homogeneous and non-homogeneous linear partial differential equations with constant coefficients and solve related problems.	PSO-1	U
3.	analyze the classification of partial differential equations in three independent variables – Cauchy's problem for a second-order partial differential equation.	PSO-3	An
4.	solve the boundary value problem for the heat equations and the wave equation.	PSO-4	Ap
5.	apply the concepts and methods in physical processes like heat transfer and electrostatics.	PSO-5	Ap

Total contact hours: 90 (Including instruction hours, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Non -linear partial differential equations of first order**					
	1.	Introduction	1	K3	Brainstorming	Questioning
	2.	Explanation of terms, compactible system of first order equations	4	K3	Heuristic Method	Recall Steps
	3.	Examples related to compactible system	3	K3	Blended Learning	Slip Test
	4.	Explaining Charpit's Method	3	K4	PPT	True or False
	5.	Example Problems related to charpit's method	2	K3	Interactive Method	Peer Discussion with questions
	6.	Solving problems using charpit's method	3	K3	Inductive Learning	Short Summary
II	**Homogeneous linear partial differential equation with constant coefficient**					
	7.	Homogeneous and non-homogeneous linear equation with constant coefficient	1	K2	Blended Learning	Questioning
	8.	Solution of finding homogeneous equation with constant coefficient, Theorem I, II	2	K2	Blended Learning	Proof Narrating
	9.	Method of finding complementary function	2	K3	Flipped Classroom	Short Answer
	10.	Working rule for finding complementary function, Alternative working rule	2	K3	Heuristic Method	MCQ

		for finding complementary function				
	11.	Examples for finding Complementary function	3	K3	Analytic Method	Recall Steps
	12.	General method and working rule for finding the particular integral of homogeneous equation and some example	2	K3	PPT	Relay Race
	13.	Examples to find the particular integral	3	K3	Brainstorming	Match the following
III	**Non – homogeneous linear partial differential equations with constant coefficient**					
	14.	Definition, Reducible and irreducible linear differential operators	3	K3	Brainstorming	Questioning
	15.	Reducible and irreducible linear partial differential equations with constant coefficient	2	K3	Interactive Method	Slip Test
	16.	Determination of complementary function	2	K2	PPT using Microsoft 365	True or False
	17.	General solution and particular integral of non-homogeneous equation and some examples of type 1	2	K2	Heuristic Method	Peer Discussion with questions
	18.	Examples of type 2	2	K2	Blended Learning	Creating Quiz with Group Discussion
	19.	Problems related to type 3	2	K5	Blended Learning	Relay Race
	20.	Examples related to type 4, Miscellaneous examples	2	K2	Inductive Learning	Questioning

		for the determination of particular integral				
IV	**Classification of Partial Differential equations of second order**					
	21.	classification of Partial Differential equations of second order	1	K1	Analytic Method	Quiz
	22.	Classification of P.D.E. in three independent variables	2	K2	Heuristic Method	MCQ – Slido
	23.	Cauchy's problem for a second order P.D.E.	3	K3	Flipped Classroom	Slip Test
	24.	Characteristic equation of the second order P.D.E	3	K4	Video using Zoom	Questioning
	25.	Characteristic curves of the second order P.D.E	1	K5	Analytic Method	Slip Test
	27.	Laplace transformation.	2	K4	Heuristic Method	True or False
	28.	Reduction to Canonical (or normal) forms.	3	K5	Flipped Classroom	Presentation
V	**Boundary Value Problem**					
	29.	A Boundary value problem, Solution by Separation of variables, Solution of one-dimensional wave equation	2	K3	Brainstorming	Questioning
	30.	D'Alembert's solution, Solution of two-dimensional wave equation	2	K3	Interactive Method	Slip Test
	31.	Vibration of a circular membrane, Examples related to vibration of a circular membrane	3	K4	PPT	True or False

	32.	Solution of one dimensional heat equation, Problems related to solution of one dimensional heat equation	2	K4	Heuristic Method	Peer Discussion with questions
	33.	Solution of two dimensional Laplace's equation	3	K4	Blended Learning	Group Discussion
	34.	Solution of two dimensional heat equation	3	K3	Analytic Method	MCQ

Sample questions

Part A

1.The system of two given PDE is compatible possess ----------
(a) no solution (b) Two solution (c) Infinitely many solutions (d) Unique solution
2. If $u_1, u_2, \ldots u_n$ are solution of the homogeneous linear PDE F(D, D') z = 0 then ----------is also a solution, where $C_1, C_2, \ldots C_n$ are arbitrary constants.
3. What is the complementary function of the partial differential equation $(D^2 – D'^2 + D – D')$ z =0 is ----------.
4. Classify the PDE 2r + 4s + 3t – 2 = 0.
5. What is the D'Alembert's solution for wave equation.

Part-B

1. Show that the equations xp =y q and z(xp + yq) = 2xyare compatible and solve them.
2. Solve (D - D') (D +D')z = (y+ 1)e^x.
3. Solve $(D^2 – DD' – 2D'^2 +2D +2D')z = \sin(2x +y)$.
4. Explain the classification of a PDE in three independent variables.
5. Find the General solution of one –dimensional wave equation $\frac{\partial^2 y}{\partial x^2} = \frac{1}{c^2}\left(\frac{\partial^2 y}{\partial t^2}\right)$.

Part-C

1. Find a complete integral of $(p^2 + q^2)^n (q x - p y) = 1$.
2. Solve r + 2s + t = 2 cos y – x sin y.
3. Solve (D+ D') (D+ D'-2)z = sin (x +2y).
4. Reduce the equation yr + (x + y) s + xt = 0 to canonical form and hence find its general solution.
5. A thin rectangular plane whose surface is impervious to heat flow has at t =0 an arbitrary distribution of temperature f(x,y). Its four edges x =0, x= a, y=0, y=b is kept at zero temperature. Determine the temperature at a point of the plate as t increases.

Course Instructor: Dr. K.Jeya Daisy HOD :Dr. T. Sheeba Helen

Teaching Plan

Department : Mathematics

Class : I M. Sc.

Title of the Course: Statistical Data Analysis using R Programming

Semester : II

Course Code : MP232EC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP232EC2	4	-	-	-	3	4	60	25	75	100

Pre-requisite:

Students should know the basic skills of computer.

Learning Objectives:

1. The basics of statistical computing and data analysis
2. How to use R for analytical programming

Course Outcomes

On the success completion of the course, students will be able to:		
1	recall R and its development history	**K1**
2	demonstrate how to import export data with R	**K2 & K4**
3	explain discrete distributions	**K3**
4	apply various concepts to write programs in R	**K3 & K5**
5	apply estimation concepts in R programming	**K2 & K3**

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Statistical Software R**					
	1.	R and its development history	3	K1	Interactive Method	MCQ
	2.	Structure of R	3	K2	PPT using Gamma	Slip Test
	3.	Installation of R	3	K4	Demonstration	Installation of R
II	**Descriptive Statistics**					
	4.	Basics of Descriptive Statistics and Examples	3	K2	Inquiry based learning	Questioning

	5.	Excurses: Data Import and Export with R	3	K3	Blended Learning	Concept Explain
	6.	Import of Intensive Care Unit-Dataset	3	K3	Hands on training	Code Race
III	**Colours and Diagrams**					
	7.	Proper knowledge of using colours	3	K2	Interactive Method	Q & A
	8.	Excursus: Export of Diagrams	3	K5	Flipped Classroom	Create a short video
	9.	An overview on Diagrams	3	K4	Brainstorming	Quiz - Kahoot
IV	**Probability Distributions**					
	10.	Introduction to Probability Distributions	2	K2	Video using OBS Studio	Class Test
	11.	Discrete Distributions	4	K4	Spiral Learning	R code construction
	12.	Continuous Distributions	3	K4	Problem based learning	Assignment
V	**Estimation**					
	13.	Introduction to Estimation	2	K2	Scaffolded learning	Presentation
	14.	Point Estimation in detail	4	K3	Active learning with pair programming	Quiz - Quizizz
	15.	Point Estimation continued	3	K3	Visualisation and simulation	Short Test

Course Focussing on **Employability and Skill Development**

Activities (SD): **Create coding for simple problems using R, Presentation depicting a real-life example, Group Discussion, SLO's**

Course Focussing on Cross Cutting Issues: -

Assignment: **Development of R programme and post in google classroom.**

Sample questions

Part A

1. R is a _____ based language.

2. Give the other name of population.

   a) sample b) universe c) explosion

3. True or False: The colour need not work everywhere.

4. True or False: The values of a random variable are called realisations.

5. Statistics is not able to _____ answer a question.

Part B

1. List the steps to install R programming language.

2. Enumerate the steps to import dataset.

3. Explain Colours.

4. Discuss different types of continuous distributions.

5. Write a note on estimation.

Part C

1. Explain in detail R and its development history.

2. Give few functions and their descriptions.

3. Depict various types of diagrams.

4. Introduce probability distributions and discuss different types of discrete distributions in detail.

5. What is your understanding of point estimation and how it is applied.

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Sr. S. Antin Mary**

Teaching Plan

Department : Mathematics

Class : I M. Sc Mathematics

Title of the Course : Mathematical Python

Semester : II

Course Code : MP232EC5

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP232EC5	3	-	1	3	4	60	25	75	100

Pre-requisite:

Students should know basic skills of computer

Learning Objectives:

1. To familiarize the students with Python programing for Mathematics.
2. To train them to develop programs and create functions for Mathematics in Python.

Course outcomes

On the successful completion of the course, student will be able to:		
1	acquire knowledge on Python and learn to run the program.	**K1**
2	understand and discuss about different data types and flow control statements.	**K2 & K4**
3	write programs in python using Lists Tuples, Sets and Dictionaries.	**K3**
4	understand For and While loops and conditional statements.	**K3 & K5**
5	creates Functions and Arrays in Python.	**K2 & K3**

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Python Getting started**					
	1.	Introduction and Installing Python	1	K2	Demonstration	Installation of Python
	2.	Different Tabs in Jupiter Notebook	4	K2	Project based Learning	Short quiz on different tabs and Jupiter notebook submissions
	3.	Starting a New Notebook	3	K2	Blended Learning	Slip Test
	4.	Magics and Markdown	1	K2	Interactive Method	MCQ
II	**Programming Python**					
	5.	Python Data Types – Numbers, Booleans	3	K3 & K6	PPT using Gamma	Code Race
	6.	Python Data Types – Strings, Formatting Strings	3	K3 & K6	Inquiry-based Learning	Create a code for mathematical problems
	7.	Python Data Types – Type Conversions, Variable Names	3	K3 & K6	Brainstorming	Questioning
	8.	Containers - Lists and Tuples	3	K3 & K6	Hands-on-training	Hands-on-coding test
	9.	Containers - Sets and Dictionaries	3	K3 & K6	PPT using Microsoft 365	MCQ
	10.	Controlling the Flow – Boolean Expressions, If Statements	3	K3 & K6	Problem based Learning	Statistical analysis on datasets using Python
	11.	Controlling the Flow – Conditional Expressions: For Loops, While Loops	3	K3 & K6	Hands-on-training	Hands-on-coding test
	12.	Break and Continue, Error Handling with Try-Except, Reading and Writing Files	3	K3 & K6	Interactive Method	Questioning

III	**Packaging and Reusing Code**					
	13.	Functions	3	K4	Flipped Classroom	Create a short video
	14.	Modules	3	K4	Inductive Learning	Python code construction
	15.	Comprehensions	2	K4	Interactive	Questioning
	16.	Generator Expressions and Comments	1	K4	Brainstorming	Questioning
IV	**Numerical Computing**					
	17.	Numpy – Array Creation	2	K3 & K6	Visualization and Simulation	Create visualization for Matrix
	18.	Array Properties	3	K3 & K6	Spiral Learning	Slip Test
	19.	Array Operations	3	K3 & K6	Scaffolded Learning	Construction of Code
	20.	Array Indexing and Slicing	2	K3 & K6	Flipped Classroom	Presentation
	21.	Indexing with Integer Arrays	1	K3 & K6	Video using Zoom	Quiz - Slido
	22.	Indexing with Boolean Arrays	1	K3 & K6	Video using Zoom	Quiz - Socrative
V	**Differential Equations**					
	23.	First Order Differential Equations	2	K3 & K5	Inquiry based Learning	Coding challenging and competitions
	24.	Higher Order Linear Equations	2	K3 & K5	Problem based Learning	Code Reviews and Peer Assessment
	25.	Systems of Equations	2	K3 & K5	Active Learning with Pair Programming	Debugging and Error-identification

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability and Skill Development**

Activities (SD): **Create a code for mathematical problems, Statistical analysis on datasets using Python, Create a short video, Coding challenging and competitions, Debugging and Error-identification**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Solving first order differential equations, Systems of Equations**

Sample questions (minimum one question from each unit)

Part A

1. Which menu bar containing all the functions available in the notebook?
   (a) Title (b) Menu (c) Tool (d) Cell
2. The value of "abcde"[1] is ……
3. True or False: The import statement is used to make the variables and functions in a module available for use.
4. Match the following.

(i). Return an array of evenly spaced integers within a given interval	(a) ones
(ii). Return a new array of a given shape and type, filled with ones	(b) arrange
(iii). Return a new array of a given shape and type, filled with zeros	(c) zeros
(iv). Return an array of evenly spaced numbers over a specified interval	d) linspace

5. Differential equations of the form $\frac{dy}{dt} = func\ (y, t, \ldots)$ can be solved using …….

Part B

1. What is Markdown. Explain the use of Markdown with an example.
2. Write the uses of bool, int, float, complex and str.
3. Generate the Python code for a polynomial with degree 5.
4. Create a Python code for 3×3 matix.
5. Solve the first order differential equation $\frac{dP}{dt} = kP\ (M - P)$ using Python.

Part C

1. Explain all the tabs in the Jupiter notebook.
2. Explain different types of strings with an example.
3. Write the functions of Math Module.
4. Explain the properties of Array.
5. Solve the systems of equations $\frac{dx}{dt} = x(a - py)$ and $\frac{dy}{dt} = y(-b + qx)$ using Python.

Head of the Department
[Dr. T. Sheeba Helen]

Course Instructor
[Dr. A. Anat Jaslin Jini]

Department : Mathematics
Class : I M.Sc.
Title of the Course : Introduction to MS Excel 2007
Semester : II
Course Code : MP242SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP242SE1	4	-	-	-	3	4	60	25	75	100

Objectives

1. To familiarize the students with Excel's basic features.

2. To acquire skills for data analysis using MS Excel.

Course outcomes

On the successful completion of the course, students will be able to:		
1.	understand the Excel interface including the ribbon, worksheets and cells	**K2**
2.	enter and format data effectively including text, numbers and formulas	**K3& K4**
3.	use basic functions like SUM, AVERAGE and COUNT for simple calculations	**K3 & K4**
4.	manage data effectively through organization, sorting and filtering	**K3 & K4**
5.	create various chart types including bar charts, line graphs, pie charts, and scatter plots to visually represent data.	**K4 & K5**

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Getting Started with Excel 2007**					
	1.	Introduction to Excel 2007 User Interface, Title Bar, Office Button , Quick Access Toolbar ,	3	K2	Context Based	Quiz Questioning in the classroom
	2.	Ribbon, Command Tabs , Contextual Tabs, Command Sets Dialog Box Launchers.	3	K2	Flipped Classroom	Oral presentation
	3.	Mini Toolbar, Live Preview, Key Tips, Super ToolTips, Name Box , Formula Bar , Work Area.	3	K3	Lecture method	MCQ
	4.	Zoom Controls, Creating a New Workbook, Using a Blank Workbook Template, Saving a Workbook.	3	K3	Cooperative Learning	Peer Reviews
	5.	Closing the Current Workbook , Opening an Existing Workbook ,Closing MS Excel.	3	K3	Context based	Online Assignment
II	**Working with Data and Data Tables**					
	6.	Introduction, Entering Data using AutoFill, AutoFill a Text Series, AutoFill a Number Series.	3	K2	Blended Learning	MCQ
	7.	Creating Your Own Custom List, Using Merge & Center, Turning on Text Wrapping.	3	K3	Brainstorming	Group Discussion
	8.	Changing Number Formats, Increasing or Decreasing	3	K3	Experimental learning	Student presentations

		Decimals in Numeric Data.				
III	**Working with Data and Data Tables**					
	9.	Sorting Data, Sorting Data using Some Predefined Criteria, Sorting Data by Defining Custom Sort Criteria.	3	K3	Reflexive thinking	Homework
	10.	Filtering Data, Linking Data, Adding a Hyperlink, Editing a Hyperlink, Removing a Hyperlink.	3	K3	Context based	Oral test.
	11.	Creating a Table, Creating a Table from a Blank Cell Range, Creating a Table from an Existing Data Range.	3	K5	Project based	Assignments
	12.	Editing a Table, Formatting a Table, Sorting a Table, Filtering a Table	3	K4	Experimental Learning	Open-Book Test
IV	**Using Formulas and Functions**					
	13.	Introduction, Understanding Formulas, Operators in Excel 2007, Operator Precedence.	3	K2	Lecture method	Quiz
	14.	Creating a Formula, Editing a Formula, Defining Range Names, Assigning a Range name, Selecting a Range, Editing a range Name.	3	K5	Blended Learning	Class test
	15.	Referencing Ranges in Formulas, Referencing Cells from Other Worksheets.	3	K3	Integrative teaching	MCQ
	16.	Using Relative and Absolute Cell	3	K3	Context based	Peer Review

		References, Understanding Functions, Some Common Excel Functions.				
	17.	Applying a Function, Editing a Function, Calculating Total of Cell Data with AutoSum.	3	K4	Reflexive thinking	Brainstorming
V	**Working with Charts**					
	18.	Introduction, Creating a chart, Changing the Chart Layout, Changing the Chart Styles.	3	K5	Context based	Surprise test
	19.	Changing the Chart Type, Adding a Chart Title, Adding Axis Titles.	3	K3	Project Based	Preparation of Question Bank by students
	20.	Adding Data Labels, Adding a Legend, Adding Gridlines.	3	K4	Cooperative learning	Seminar Presentations

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Skill Development Activities (SD): Create a chart from real data, Sorting and filtering Relay, Data Entry and formatting challenge.

Assignment: Working with Charts

Sample questions (minimum one question from each unit)

Part A

1. What is the Ribbon in Excel 2007?
2. What is AutoFill in Excel 2007?
3. What is a hyperlink in Excel, and how can it be used?
4. What is a cell reference?
5. What is a chart in Excel?

Part B

1. Explain the functions of the Quick Access Toolbar and the Office Button in Excel 2007.
2. Explain how to create a custom list in Excel 2007.
3. Explain how to filter data in Excel 2007.
4. Differentiate between relative and absolute cell references in Excel 2007.
5. Describe the steps to add a title to an Excel chart.

Part C

1. Describe the Excel 2007 user interface, highlighting the purpose of elements such as the Title Bar, Ribbon, Formula Bar, and Work Area.
2. Discuss various ways to enter and format data in Excel 2007, including using AutoFill, text wrapping, and adjusting number formats.
3. Describe the process of creating, formatting, and sorting tables in Excel 2007. Include details on using custom sort criteria and linking data.
4. Explain the process of creating formulas and using functions in Excel 2007, with examples of common functions like SUM, AVERAGE, and COUNT.
5. Discuss how to create and format charts in Excel 2007. Explain how to customize chart layouts, styles, and add elements like data labels and legends.

Head of the Department
Dr. T. Sheeba Helen

Course Instructor
Dr. T. Sheeba Helen

Department : Mathematics
Class : II M.Sc Mathematics
Title of the Course : Major Core XIII -Functional Analysis
Semester : IV
Course Code : MP234CC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
PM2033	6	-	-	5	6	90	25	75	100

Objectives

1. To study the three structure theorems of Functional Analysis and to introduce Hilber Spaces and Operator theory.
2. To enable the students to pursue research.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	Learn and understand the definition of linear space , normed linear space, Banach Space and their examples	PSO - 1	K1(R)
CO - 2	Explain the concept of different properties of Banach Spaces, Hahn Banach theorem	PSO -2	K2(U)
CO - 3	Compare different types of operators and their properties, Natural imbedding	PSO - 2	K3(Ap)
CO - 4	Explain the ideas needed for open mapping theorem , Open Mapping theorem	PSO - 1	K5(C)
CO - 5	Construct the idea of projections , the spectrum of an operator and develop problem solving skills , Matrices, Determinants	PSO - 1	K3(Ap)
CO - 6	Learn and understand the definition of Hilbert Spaces ,Orthogonal Complements	PSO - 4	K1(R)
CO - 7	Explain the concept of the adjoint of an operator, Normal and Unitary operators, Spectral Theory	PSO - 2	K4(An)

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Banach spaces**					
	1.	Banach spaces	4	K2(U)	Lecture with Illustration	Evaluation through slido, MCQ
	2.	Definition and examples	2	K1(R)	Blended classroom	Simple definitions, MCQ, Recall steps, Concept definitions
	3.	Continuous linear transformations	4	K2(U)	Flipped Classroom	Slip Test using Quizziz
	4.	The Hahn Banach theorem.	5	K4(An)	Integrative method	Evaluation through short test, Seminar
II	**The natural imbedding of N into N****					
	1.	The natural imbedding of N into N**	5	K1(R)	Group Discussion	Questioning
	2.	The open mapping theorem	5	K2(U)	Integrative method	Evaluation through slido
	3.	The conjugate of an operator.	5	K4(An)	Peer Instruction	Slip Test using Quizziz
III	**Hilbert spaces**					
	1.	Hilbert spaces	4	K1(R)	Brainstorming	Quiz
	2.	Definition and properties	4	K3(Ap)	Lecture	Concept Explanation
	3.	Orthogonal complements - Orthonormal sets	4	K3(Ap)	Lecture Discussion	Slip Test
	4.	The conjugate space	3	K5(C)	Lecture	Evaluation through quiz test using quizziz
IV	**Adjoint of an operator**					

	1.	Adjoint of an operator, self adjoint operators	3	K2(U)	Lecture, Introductory session	Evaluation through quiz test using quizziz, Seminar, MCQ, Recall steps
	2.	Normal and unitary operators	3	K1(R)	Group Discussion	Questioning
	3.	Projections	3	K3(Ap)	Lecture with Illustration	Evaluation through slido, MCQ
	4.	Spectral theory - Spectrum of an operator	3	K4(An)	Blended classroom	Simple definitions, MCQ, Recall steps, Concept definitions
	5.	The spectral theorem	3	K2(U)	Flipped Classroom	Slip Test using Quizziz
V	**Banach Algebras**					
	1.	Banach Algebras: The definition and some examples	3	K2(U)	Seminar Presentation	MCQ
	2.	Regular and singular elements	3	K2(U)	Seminar Presentation	Concept explanations
	3.	Topological divisors of zero	2	K4(An)	Seminar Presentation	Evaluation through slido
	4.	The spectrum	3	K4(An)	Seminar Presentation	Questioning
	5.	The formula for the spectral radius	4	K3(Ap)	Seminar Presentation	Slip Test

Course Focussing on Skill Development

Activities (Em/ En/SD): Evaluation through model making Competition

Assignment : Orthonormal sets (PPT)

Seminar Topic: Adjoint of an operator

Sample questions

Part A

1. Let x, y be elements of a Hilbert space H, such that $\| x \| = 3, \| y \| = 4$ and $\| x+y \| = 7$. Then $\| x-y \|$ equals:

   (a) 1 (b) 2 (c) 3 (d) $\sqrt{2}$

2. Choose the correct answer for the following norm$\|T^*T\|$ =

(a) $\|T^*\|\|T\|$(b)$\|T\|^2$ (c)$\|T^*\|^2$ (d) $\|T^2\|$.

3. The weak * topology is weaker than the .....topology.

4. Say True or False

The Hilbert cube is compact as a subspace of l_2

5. (T_1 T_2)* =……..

Part B

1. State and prove Holder's inequality.
2. State and prove the Closed theorem.
3. State and prove the Schwartz inequality.
4. Show that a closed linear subspace M of H is invariant under an operator $T \Leftrightarrow M^{\perp}$ is invariant under T*.
5. Show that if T is normal then each M_i reduces T.

Part C

1. State and prove the Hahn Banach Theorem.

2. Show that a closed convex subset C of a Hilbert space H contains a unique vector of smallest norm.

3. State and prove the open mapping theorem.
4. If T is an operator on H for which <Tx, x> = 0. For all x, prove that T = 0.
5. State and prove the spectral theorem.

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen Dr. A. Jancy Vini

Teaching Plan

Department: Mathematics

Class: II M.Sc. Mathematics

Title of the Course: Core course XI: Probability Theory
Semester: III

Course Code: MP234CC2

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP234CC2	6	-	-	5	6	90	25	75	100

Learning Objectives:

1. To upgrade the knowledge of Probability theory
2. To solve NET /SET related Probability theory problems

Course Outcomes

On the successful completion of the course, students will be able to:		
1	recall the basic probability axioms, conditional probability, random variables, and related concepts	**K1**
2	define Special Mathematical Expectations, The Binomial Distribution, and The Poisson Distribution.	**K2**
3	define The Exponential, Gamma, and Chi-square Distributions, The Normal Distribution.	**K2**
4	study Bivariate Distributions of discrete, and continuous types, The correlation coefficient, Conditional Distribution, and The Bivariate Normal Distribution.	**K5**
5	discuss Functions of one random variable, Transformations of two random variables, The central limit Theorem, Chebyshve's inequality, and convergence in probability, Limiting moment-generating functions.	**K3, K4**

Total contact hours: 90 (Including instruction hours, assignments, and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Probability**					
	1.	Properties of Probability	4	K1, K2	Recall the basic definitions	Questioning
	2.	Methods of enumeration	4	K4, K5	Lecture with illustration	Summarize the concepts
	3.	Conditional Probability	5	K2, K5	Illustrative Method	Questioning
	4.	Independence Events, Baye's Theorem	5	K2, K5	Interactive teaching	Question and answer
II	**Discrete Distributions**					
	1.	Random Variables of the Discrete Type	6	K1	Flipped classroom	Questioning
	2.	Mathematical Expectation, Special Mathematical Expectation	6	K2	Discussion and Lecture	Slip test
	3.	The Binomial Distribution, The Poisson Distribution	6	K2	Inquiry based teaching	Q & A
III	**Continuous Distributions**					
	1.	Random variables of continuous type	6	K2	Lecture	Short test
	2.	The Exponential, Gamma, and Chi-square Distributions	6	K3, K4	Flipped Classroom	Problem-solving
	3.	The Normal Distribution	6	K3, K4	Brainstorming	Short test
IV	**Bivariate Distributions**					
	1.	Bivariate Distributions of discrete type	3	K1 & K2	Collaborative group work	Quiz
	2.	The correlation coefficient	3	K3	Lecture	True/False

	3.	The Conditional Distribution	4	K2	Lecture	Concept Explanation
	4.	Bivariate Distributions of continuous type	4	K3, K4	Lecture with chalk and talk	Slip Test
	5.	Bivariate Normal Distribution	4	K2, K4	Lecture Discussion	Q& A
V	**Distributions of functions of Random variables**					
	1.	Functions of one random variable	3	K2	Seminar Presentation	Explain
	2.	Transformations of two random variable, Several random variables	5	K2, K4	Lecture with Comparative Analysis	Concept explanations
	3.	The central limit Theorem, Chebyshve's inequality and convergence in probability	6	K3, K4	Lecture with illustration	Questioning
	4.	Limiting moment generating functions	4	K2	Seminar Presentation	Recall steps

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development**

Activities (Em/ En/SD): **Problem-solving, Seminar Presentation, Group Discussion**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Solving Exercise Problems**

Seminar Topic: **Transformations of two random variable, Several random variables and Limiting moment generating functions**

Sample questions

Part A

1. If two events A and B are independent, which of the following is true?

a) $P(A \cap B) = P(A) + P(B)$ b) $P(A \cap B) = P(A) * P(B)$
c) $P(A \mid B) = 0$ d) $P(A \cup B) = P(A) * P(B)$

2. Which of the following describes a discrete random variable?

a) Temperature measurements b) Height of individuals
c) Number of students in a class d) Time taken to complete a task

3. For a binomial distribution, if $n = 10$ and $p = 0.5$, what is the expected value?

a) 2.5 b) 5 c) 10 d) 15

4. Define the moment-generating function.

5. The central limit theorem states that the distribution of sample means approaches a normal distribution as:

a) Sample size decreases b) Variance increases
c) Sample size increases d) Mean decreases

Part B

1. Calculate $P(A \cup B)$ if $P(A) = 0.4$, $P(B) = 0.5$, and $P(A \cap B) = 0.2$.

2. If $P(A) = 0.5$ and $P(B|A) = 0.7$, find $P(A \cap B)$.

3. Using the multiplication rule, find the probability of drawing two consecutive hearts from a deck without replacement.

4. Calculate the variance of the binomial distribution with $n = 10$ and $p = 0.5$.

5. Given a normal distribution with mean 10 and variance 4, find the probability that a randomly selected value is less than 12.

Part C

1. State and prove Baye's theorem.

2. Explain Chebyshev's Inequality and solve a related problem to demonstrate its use in probability.

3. Solve: A survey shows that 60% of people like coffee, 50% like tea, and 30% like both. What is the probability that a randomly selected person likes either coffee or tea?

4. Solve: For a random variable X with $P(X = 1) = 0.2$, $P(X = 2) = 0.5$, and $P(X = 3) = 0.3$, calculate E(X) and Var(X).

5. State and prove the central limit theorem

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Dr. J. Befija Minnie**

TEACHING PLAN

Department: Mathematics

Class: II M. Sc Mathematics

Title of the Course: Core Course XII: Numerical Analysis

Semester: IV

Course Code: MP234CC3

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP234CC3	**5**	-	-	-	**5**	6	**90**	**25**	**75**	**100**

Learning Objectives:

1. Understand fundamental numerical analysis techniques and their applications.
2. Develop proficiency in implementing numerical algorithms using computational tools.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall and list basic numerical methods covered in the course, including root-finding algorithms and interpolation techniques.	PSO - 1	K1(R)
CO - 2	understand the principles behind key numerical algorithms such as Newton's method, Gaussian elimination, and Runge-Kutta methods.	PSO - 2	K_2(U)
CO - 3	apply numerical methods to solve algebraic equations, interpolate data points, fit curves to data sets, and solve systems of linear equations.	PSO - 3	K_3(Ap)
CO - 4	analyse the accuracy, convergence, and stability of numerical solutions obtained using different techniques.	PSO - 3	K_4(An)
CO - 5	evaluate the suitability and effectiveness of various numerical methods for specific mathematical problems based on computational efficiency and solution quality.	PSO - 2	K_5(E)

Teaching plan

Total Contact hours: 90 (Including lectures, assignments, and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	Solution of Algebraic and Transcendental Equations - Introduction –Iteration Method	5	K_2(U)	Introductory session, Group Discussion. PPT.	Evaluation through short test, MCQ, True/False.
	2.	Newton-Raphson Method- Ramanujan's Method	5	K_3(Ap)	Transmissive method using Chalk and talk, Problem-solving, Group Discussion.	Simple definitions, Recall steps,
	3.	Secant Method - Muller's Method.	5	K_3(Ap)	Transmissive method using Chalk and talk, Problem-solving, Group Discussion.	solve problems, and explain
II	1.	Differences of a polynomial - Newton's formulae for Interpolation - Central Difference Interpolation formulae	5	K_1(R)	Problem-solving, Demonstration.	MCQ, True/False.
	2.	Gauss's central difference formulae - Stirling's formula - Bessel's formula	5	K_2(U)	Problem-solving, Group Peer tutoring.	Evaluation through short tests.
	3.	Everett's formula - Relation between Bessel's and Everett's formulae - Practical Interpolation.	5	K_3(Ap)	Transmissive method using videos, Problem-solving.	Presentations
III	1.	Least squares and Fourier Transforms - Introduction - Least squares Curve Fitting	5	K_2(U)	Transmissive method using videos.	Evaluation through short tests.
	2.	Procedure Fitting a straight line - Multiple Linear Least squares	5	K_2(U)	Introductory session, Group Discussion.	MCQ, True/False.
	3.	Linearization of Nonlinear laws - Curve fitting by Polynomials.	5	K_4(An)	PPT, Review.	Evaluation through short tests, Seminar.

IV	1.	Numerical Linear Algebra - Introduction - Triangular Matrices - LU Decomposition of a matrix -	3	K_1(R)	Peer tutoring, Transmissive method using videos.	Evaluation through short tests.
	2.	Solution of Linear systems - Direct Methods - Gauss elimination	4	K_2(U)	Transmissive method using Chalk and talk, Problem-solving.	Concept definitions
	3.	Necessity for Pivoting - Gauss - Jordan method - Modification of the Gauss method to compute the inverse	4	K_3(Ap)	Problem-solving, Group Discussion.	MCQ, True/False.
	4.	LU Decomposition method - Solution of Linear systems - Iterative methods.	4	K_4(An)	Transmissive method using Chalk and talk, Problem-solving, Group Discussion.	Concept definitions, Seminar.
V	1.	Numerical Solution of Ordinary Differential Equations - Solution by Taylor's series	5	K_2(U)	Peer tutoring, Lectures using videos.	Evaluation through short tests, Seminar.
	2.	Euler's method - Runge - Kutta methods - II order and IV order	5	K_3(Ap)	Problem-solving, PPT.	Seminar.
	3.	Numerical Integration – Trapezoidal Rule – Simpson's 1/3– Rule - Simpson's 3/8– Rule.	5	K_4(An)	Transmissive method using Chalk and talk, Problem-solving, Group Discussion.	Concept explanations, Seminar.

Course Focussing on Employability/ Entrepreneurship/ Skill Development: (Mention)

Activities (Em/ En/SD): Online Assignments, Open Book Test, and Group Discussions

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): (Mention)

Activities related to Cross Cutting Issues:

Assignment: Solution of Algebraic and Transcendental Equations -Introduction; Iteration Method (Online)

Seminar Topic: Differences of a polynomial - Newton's formulae for Interpolation - Central Difference Interpolation formulae.

Sample questions (minimum one question from each unit)

Unit I:

Part A: True or False: Every Polynomial equation of the n^{th} degree has n and only n roots.

Part B: Find a real root of equation $x^3 = 1- x^2$ on the interval [0, 1] with an accuracy of 10^{-4}

Part C: Use the Iterative method to find the real root of the equation sin x = 10(x-1). Correct to three decimal places.

Unit II:

Part A: Everett's formula will be easier to apply, since it uses only the ------order differences.

Part B: Derive the relation between Bessel's formula and Everett's formula.

Part C: Derive Bessel's formula.

Unit III:

Part A: True or False: The given data may not always follow a linear relationship.

Part B: Fit the second-degree parabola $y = a + bx + cx^2$ to the data (x_i, y_i); (1,0.63), (3, 2.05), (4, 4.08), (6, 10.78)

Part C: Explain Linearization of Nonlinear laws with example.

Unit IV:

Part A: Define the norm of a vector.

Part B: Factorize the matrix A = $\begin{pmatrix} -1 & 2 & 3 \\ 3 & 1 & 0 \\ 0 & 5 & 3 \end{pmatrix}$ in to LU form.

Part C: Derive a LU decomposition of a matrix.

Unit V:

Part A: The Second order Runge - Kutta formula is -------

Part B: Derive Trapezoidal rule.

Part C: Derive Simpson's 3/8 th rule.

Head of the Department: Dr. T. Sheeba Helen

Course Instructor: Mrs. J C Mahizha

Teaching Plan

Department : Mathematics

Class : II M. Sc Mathematics

Title of the Course : ELECTIVE COURSE VI :b) FOUNDATIONS OF COMPUTER NETWORKING

Semester : IV

Course Code : MP234EC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP234EC2	4	-	-	-	3	4	60	25	75	100

Pre-requisite:

1. Basic understanding of computer science fundamentals, including data structures and algorithms.
2. Basic networking concepts such as IP addressing, routing, and switching.

Learning Objectives:

1. To understand the fundamental principles and components of network hardware, reference models, and protocols.
2. To analyze and apply various networking concepts such as data link layer design, routing algorithms, congestion control, and transport layer protocols.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	demonstrate a thorough understanding of network hardware, reference models (such as OSI and TCP/IP), and the architecture of the Public Switched Telephone Network (PSTN).	**K2**
2	describe the architecture and services of the application layer, analyze protocols such as HTTP for web communication, and understand the principles of streaming media and real-time conferencing over networks.	**K2, K4**
3	design data link layer protocols, analyze error detection and correction techniques, and implement routing algorithms for efficient data transmission.	**K3, K4**
4	develop skills in identifying congestion control issues, apply appropriate congestion control algorithms, and implement traffic-aware routing strategies to optimize network performance.	**K3, K4**
5	demonstrate proficiency in analyzing and implementing transport layer protocols, particularly TCP, including connection establishment, data transfer, and connection release mechanisms.	**K4**

K2 - Understand; **K3** – Apply; **K4 -** Analyse;

Teaching plan

Total Contact Hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Introduction – Network Hardware**					
	1	Introduction: Local Area Networks – Wide Area Networks.	3	K2	Interactive Diagrams	Class Discussions
	2	Reference Models: The OSI Reference Model – The TCP/IP Reference Model	3	K2	Concept Mapping	Concept Map Evaluation
	3	The Physical Layer – Guided Transmission Media	3	K2	Illustrative Method	Diagram Labeling Tests
	4	Magnetic Media – Twister Pairs – Coaxial Cable – Power Lines – Fiber Optics.	3	K2	Case-Based Learning	Case Study Reports
II	**The Public Switched Telephone Network**					
	1	Structure of the Telephone System – The Local Loop: Modems, ADSL and Fiber – Switching.	3	K3	Flipped Classroom,	Peer Assessments
	2	The Data Link Layer: Data Link Layer Design Issues: Framing	3	K4	Demonstration Method	Class Discussions

	3	Error Detection and Correction: Error-Correcting Codes – Error-Detecting Codes	3	K3	Problem-Based Learning	Group Projects
	4	Sliding Window Protocols: A One-Bit Sliding Window Protocol – A Protocol using Go-Back – A Protocol using Selective Repeat.	3	K3	Inductive Learning	Questioning
III	**The Network Layer – Network Layer Design Issues**					
	1	Store-and-Forward Packet Switching	3	K2	Collaborative Learning	Evaluation through short test
	2	Routing Algorithms: Shortest Path Algorithm – Distance Vector Routing	3	K4	Gamification	Gamified Challenges
	3	Congestion Control Algorithms: Approaches to Congestion Control	3	K3	Interactive Lectures	Slip Test
	4	Traffic-Aware Routing.	3	K3	Gamification	Quiz Competition
IV	**The Transport Layer – Congestion Control**					
	1	Desirable Bandwidth Allocation – Regulating the Sending Rate – Wireless Issues.	3	K3	Interactive Method	Peer Discussion with questions
	2	The Internet Transport Protocols:Introduction to TCP – The TCP Protocol	3	K2	Flipped Classroom	Practical Exams
	3	The TCP Segment Header – TCP Connection Establishment – TCP Connection Release.	3	K4	Hands-on Learning	Evaluation through short test

V	The Application Layer – Electronic Mail					
	1	Architecture and Services – The User Agent – Message Formats – Message Transfer – Final Delivery	3	K2	Collaborative Learning	Peer Reviews
	2	The World Wide Web: Architectural Overview – Static Web Pages – Dynamic Web Pages and Web Applications	3	K3	Interactive Learning	Web Development Projects
	3	HTTP-The Hyper Text Transfer Protocol – The Mobile Web – Web Search	3	K3	Blended Learning	Slip Test
	4	Streaming Audio and Video: Digital Audio – Digital Video	3	K4	Flipped Classroom	Presentations
	5	Streaming Stored Media – Streaming Live Media – Real-Time Conferencing.	3	K4	Experiential Learning	Practical Tests, Presentations

Course Focussing on Skill Development.

Activities (Em/ En/SD): Evaluation through short test, Seminar

Assignment: Exploring Networking Technologies: From LANs to the Web and Streaming Media.

Seminar Topic: The Network Layer – Network Layer Design Issues

Sample questions

Part A

1. Which layer in the OSI model is responsible for error control and flow control?

   a) Physical Layer b) Data Link Layer

   c) Network Layer d) Application Layer

2. Which component of the telephone system is known as the "last mile"?

   a) Modem b) Local loop

   c) Toll office d) DSLAM

3. The shortest path algorithm always chooses the path with the fewest hops between nodes.

4. What is the function of the TCP three-way handshake?

   a) To terminate a connection securely.

   b) To establish a reliable connection between sender and receiver.

   c) To ensure all packets are sent in the correct order.

   d) To check network bandwidth before transmission.

5. What is the main purpose of MIME in email?

   a) To provide a standard format for text-only messages

   b) To allow multimedia content like images and audio to be sent in emails

   c) To enable the encryption of email messages

   d) To allow users to access their email on mobile devices

Part B

1. Explain the characteristics of Local Area Networks (LANs) and discuss their typical uses.

2. Explain the difference between circuit switching and packet switching in the telephone network.

3. What is the distance vector routing algorithm, and how does it operate?

4. Describe the AIMD control law used in TCP for congestion control.

5. Describe the architecture of the World Wide Web.

Part C

1. Discuss guided transmission media used in computer networks, including twisted pair, coaxial cable, and fiber optics. Describe their characteristics, advantages, and disadvantages.

2. Explain ADSL technology and its advantages over traditional dial-up modems.

3. Explain Dijkstra's shortest path algorithm and discuss its application in routing.

4. Describe TCP connection establishment and termination using the three-way handshake and four-way handshake.

5. Describe the process of message transfer in an email system using SMTP. Explain how IMAP and POP3 differ from SMTP.

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen Dr. V. Sujin Flower

Department : Mathematics

Class : II M.Sc Mathematics

Title of the Course : Core Course VII - STOCHASTIC PROCESS

Semester :IV

Course Code : MP234EC6

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP234EC6	**3**	1	-	-	**3**	**4**	**60**	**25**	**75**	**100**

Pre-requisite:

Basic Probability Theory

Learning Objectives:

1.To understand the stochastic models.

2.To relate the models studied to real life probabilistic situations.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the basic results of Markov Chains as Graphs- Higher Transition Probabilities	**K1**
2.	understand Stability of a Markov System	**K2**
3.	apply Generalisations of Poison Process-Poison Process in Higher Dimensions-	**K3**
4.	determine Discrete Stat Space-Introduction-Chapman-Kolmogorov Equations	**K4**
5.	calculate the possible partitions of a given number and draw Ferrer's graph	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate;

Teaching Plan

Total contact hours: 60 (Including instruction hours, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	Groups.					
	1.	An Introduction-Specification of Stochastic Processes-: Communication Relations-	2	K1	Brainstorming	Evaluation through test
	2.	Definition and Examples-Transition Matrix (or Matrix of Transition Probabilities)- Order of a Markov Chain	3	K1 & K6	Illustrative Method	Q&A
	3.	Markov Chains as Graphs-Higher Transition Probabilities-Generalisation of Independent Bernoulli Trials	2	K1 & K6	Content based	Open Book Assignment
	4.	Sequence of Chain-Dependent Trials-Markov-Bernoulli Chain-Correlated Random Walk-Classification of States and Chains-	2	K2 & K6	Chalk and Talk	Quiz
	5.	Class Property-Classification of Chains-Classification of States: Transient and Persistent(Recurrent) States	2	K2 & K6	Illustrative method	Group Discussion
	6.	Persistent(Recurrent) States	1	K2 & K6	Content based	Q&A
II	Sub Groups					
	1.	Determination of Higher Transition Probabilities	2	K1 & K2	Brainstorming	Test
	2.	Computation of the Equilibrium Probalities-Graph Theoretic Approach	2	K2	Flipped Class	Assignment

	3.	Markov Chain with Denumerable Number of States-Reducible Chains-Finite Reducible Chains with a Single Closed Class	2	K2	Illustrative Method	Questioning
	4.	Chain with One Single Class of Persistent Non-null Aperiodic States-Absorbing Markov Chains	2	K2 & K3	Content based	MCQ
	5.	Aperiodic Chain: Limiting Behaviour-Stability of a Markov System –--Extension: Reducible Chain with one Closed class of Persistent	2	K2	Collaborative learning	Home work
	6.	Aperiodic States- Further Extension: Reducible Chains with more than one Closed Class	2	K2 & K3	Content Based	Slip Test

III	Normal Subgroups					
	1.	Poisson Process-Introduction	2	K1	Brainstorming	Quiz
	2.	Postulates for Poisson Process-Properties of Poisson Process	3	K4	Content Based	Slip Test
	3.	Poisson Process and Related Distributions-Interarrival Time	2	K1	Illustrative Method	Test
	4.	Further Interesting Properties of Poison Process	3	K4	Chalk and Talk	Questioning
	5.	Generalisations of Poison Process-Poison Process in Higher Dimensions-Poisson Cluster Process(Compound	2	K2 & K3	Collaborative learning	MCQ
IV	Rings					
	1.	Birth and Death Process-Particular Cases Stationary Processes-Second-Order Processes-Stationarity-Gaussian Processes	2	K1	Brainstorming	Quiz

	2.	Markov Processes with Discrete Stat Space	3	K4	Collaborative learning	Questioning
	3.	Introduction-Chapman-Kolmogorov Equations	2	K2 & K3	Content based	Slip Test
	4.	Limiting Distribution (Erodicity of Homogeneous Markov Process).	2	K2	Illustrative Method	Home Work
	5.	Stationary Processes-Second-Order Processes	2	K1 & K5	Chalk and Talk	Assignment
	6.	Stationarity-Gaussian Processes	1	K3	Flipped Class	Recall Concepts
V	Ideals					
	1.	Time Series : Introduction-Purely Random Process.	2	K1	Brainstorming	Open book test
	2.	First Order Markov Process-Moving Average(MA) Process	2	K6	Collaborative learning	Questioning
	3.	Autoregressive Process(AR Process)-Autoregressive Process of Order Two(Yule Process)-Autoregressive Morning Average Process(ARMA Process)	2	K1 & K3	Content based	Slip test
	4.	Process time and Frequency Domain:Power Supremum	2	K3	Flipped Class	Assignment
	5.	Properties of Covariance and Correlation Functions	2	K5	Chalk and Talk	MCQ
	6.	Continuous Parameter Processes-Statistical Analysis of Time Series : Some Observations	2	K4	Blended learning	Concept Explanation

Course Focussing on Employability/ Entrepreneurship/ Skill Development:

Employability.

Activities (Em/ En/SD): Poster Presentation, Model Making (Application of algebraic concept).

Assignment: Solving transition probability Matrix Problems.

Sample questions

Part A(each one mark)

1. **What is the term for a sequence of random variables indexed by time?**

a) Process b) Time c) Stationary

a)

2. **What is the distribution type in which the probability of events depends only on their distance in time?**

   a) Process b) Time c) Stationary

3. **---------- describes a process where the future is independent of the past given the present?**

4. **What type of process is described by a finite number of states?**

   a) Markov Process b) Discrete c) Stationary

5. **State True or False**

   Stationary is essential for predicting the long-run proportion of time spent in each state in a Markov chain

Part B(6 marks each)

1. **Explain the concept of a Markov Process and give an example.**
2. **What is Brownian Motion? Describe its basic characteristics and importance in stochastic processes.**
3. **Explain Stationarity in the context of stochastic processes. How does weak stationarity differ from strong stationarity?**
4. **Describe Transition Probabilities in a Markov chain. How do they relate to the behavior of the process?**
5. **Outline the concept of Renewal Process and explain how it applies to real-world situations.**

Part C (12 marks each)

1. **Derive the Chapman-Kolmogorov equations for a Markov chain and explain their significance in analyzing transitions.**
2. **Discuss the Kolmogorov Forward and Backward equations in continuous-time Markov chains. Provide examples of their applications.**
3. **Describe the Central Limit Theorem for Stochastic Processes and its applications in financial modeling.**
4. **Define a Gaussian Process. Derive and discuss the properties of a Gaussian process, highlighting its importance in machine learning and prediction.**
5. **Analyze the Birth-Death Process in a queuing system and derive the steady-state probabilities for a simple case.**

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Dr.L.Jesmalar**

Teaching Plan

Department : Mathematics

Class : II M. Sc Mathematics

Title of the Course : SKILL ENHANCEMENT COURSE III: TRAINING FOR COMPETITIVE EXAMINATIONS

Semester : IV

Course Code : MP234SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP234SE1	4	-	-	-	2	4	60	25	75	100

Pre-requisite:

Strong foundation in algebraic fundamentals, basic number theory, and familiarity with sets and set operations.

Learning Objectives:

1. To solve problems needed for various competitive examinations.
2. To develop a comprehensive understanding of algebraic principles enabling proficient problem-solving in various Mathematical contexts.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	describe the concepts of topological properties of metric spaces.	**K1**
2.	associate the concept of continuity and connectedness	**K2**
3.	apply Cauchy's integral formula and Maximum modulus principle to evaluate integral	**K3**
4.	outline Liouville's theorem and open mapping theorem	**K4**
5.	built the mental ability to face GATE, CSIR and SET examinations	**K5**

K1 - Remember; K2 - Understand; K3 – Apply; K4 - Analyse; K5 - Evaluate

Teaching plan

Total Contact Hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1	Introduction – Metric Spaces	3	K1	Lecture Introduction	Conceptual quizzes
	2	Problems in metric spaces	3	K2	Peer Teaching	Group Activity
	3	Problems in Convergence	3	K2	Problem Solving	Assignment
	4	Problems in Completeness	3	K3	Collaborative Learning	Short Test
II						
	1	Problems in connectedness	4	K3	Flipped Classroom,	Peer Assessments
	2	Problems in continuity	4	K4	Demonstration Method	Class Discussions
	3	Problems in totally bounded	4	K3	Problem-Based Learning	Group Projects
III						
	1	Problems in algebra of complex numbers	2	K2	Interactive Lectures	Evaluation through short test
	2	Problems in complex plane	2	K4	Hands-on Exercises	Worksheets
	3	Problems in polynomials, Power Series	2	K3	Interactive Lectures	Slip Test

	4	Problems in transcendental functions such as exponential trigonometric and hyperbolic functions	2	K3	Think-Pair-Share	Quiz Competition
	5	Problems in Analytic Functions	2	K3	Inquiry-Based Learning	Assignment
	6	Problems in Cauchy – Riemann equations	2	K4	Example-Based Learning	Short Test
IV						
	1	Problems in contour integral	2	K3	Interactive Method	Peer Discussion with questions
	2	Problems in Cauchy theorem, Cauchy's integral formula, Liouville's theorem	3	K2	Flipped Classroom	Group Activity
	3	Problems in Maximum modulus principle	3	K4	Hands-on Learning	Evaluation through short test
	4	Problems in Schwarz lemma	2	K3	Inquiry-Based Learning	Worksheet
	5	Problems in open mapping Theorem	2	K4	Peer Teaching	Group Activity
V						
	1	Problems in Taylors Series	3	K2	Collaborative Learning	Peer Reviews
	2	Problems in Laurents Series	2	K3	step-by-Step Learning	Interactive discussions

	3	Problems in calculus of residues	2	K3	Blended Learning	Slip Test
	4	Problems in Conformal mappings	3	K4	Flipped Classroom	Presentations
	5	Problems in Mobius transformations	2	K4	Problem-Centric Approach	Practical Tests, Presentations

Course Focussing on Skill Development.

Activities (Em/ En/SD): Group presentations, Group discussions

Assignment: Find the Taylor and Laurent series expansions for given functions.

Seminar Topic: The Network Layer – Network Layer Design Issues

Sample questions

Part A

1. A: Every convergent sequence is a Cauchy sequence.
   B: Every Cauchy sequence is a convergent sequence.
   a) A and B are false b) A is true
   c) B is true d) A and B both true
2. In a totally bounded metric space, which of the following statements is true?
   A) Every sequence converges
   B) Every sequence has a Cauchy subsequence
   C) Every sequence has a convergent subsequence
   D) The space is always complete
3. Which of the following is a root of the polynomial $z^2 + 1 = 0$?
   a) 1 b) −1 c) i d) 0
4. Which of the following is a direct consequence of Liouville's Theorem?
   a) A bounded entire function must be constant
   b) A function with no singularities in the complex plane must be constant
   c) A function analytic in a compact set must be constant
   d) A function that maps the unit disk to itself must be constant
5. Which of the following properties is true for a conformal mapping?
   a) It preserves angles but not shapes

b) It preserves both angles and shapes

c) It preserves shapes but not angles

d) It maps circles to circles only

Part B

1. Show that the sequence $x_n = 1/n$ is a Cauchy sequence in $\mathbb{R}$ with the usual metric.
2. Prove that the set $S = \{x \in \mathbb{R} : 0 \leq x \leq 1\}$ is totally bounded with respect to the usual metric on $\mathbb{R}$.
3. Show that $f(z)=z^2+iz$ satisfies the Cauchy-Riemann equations.
4. Apply Cauchy's Integral Formula to find the value of f(a) for the function $f(z) = 1/(z^2 + 1)$ inside a contour C enclosing z = i.
5. Find the Laurent series for $f(z)=1/(z(z-1))$ about z=0.

Part C

1. i) Explain why the sequence $x_n = (1/n, 0)$ is Cauchy and converges to (0,0) in $\mathbb{R}^2$.

   ii) Show that [0,1] is a connected subset of R.
2. Let $f(x) = x^3$ on $\mathbb{R}$. Prove that f is continuous on $\mathbb{R}$.
3. Show that the roots of $z^3-1 = 0$ are equally spaced on the unit circle in the complex plane.
4. Find the residue of $f(z) = e^z / (z^2+1)$ at z = i.
5. Find the Taylor series expansion of $f(z) = e^z$ around z = 0 and determine its radius of convergence..

Head of the Department **Course Instructors**

Dr. T. Sheeba Helen Dr. V. Sujin Flower & Sr. S. Antin Mary