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 (SF)

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**

Teaching Plan

Department : Mathematics (SF)
Class : I M.Sc. Mathematics (SF)
Title of the Course : Core IV: Advanced Algebra
Semester : II
Course Code : MP232CC1

Course Code	L	T	P	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

CO	Upon completion of this course, the students will be able to:	Cognitive level
CO -1	exhibit a foundational understanding of essential concepts, including field extensions, roots of polynomials, Galois Theory, and finite extensions	K1 (R)
CO - 2	demonstrate knowledge and understanding of the fundamental concepts including extension fields, Galois Theory, automorphisms and finite fields	K2 (U)
CO - 3	compose clear and accurate proofs using the concepts of field extension, Galois Theory and finite field	K3 (Ap)
CO - 4	examine the relationships between different types of field extensions and their implications by applying algebraic reasoning	K4 (An)
CO - 5	evaluate the validity of statements and theorems in field theory by providing proofs or counter examples	K5 (E)
CO - 6	develop novel results or theorems in field theory, potentially by exploring extensions of existing theories	K6 (C)

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

Unit	Module	Topics	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1	Extension Fields, dimension, subfield-Introduction and definition, Theorems based on extension fields	4	K2 (U)	Introductory session, Lecture with illustration	Questioning, Recall steps, concept with examples
	2	Definition and Theorems on algebraic over a field F, Theorems on algebraic extension	4	K4 (An)	Flipped classroom	Group discussion
	3	Interpretation of Extension fields such as finite extension, algebraic extension	5	K3 (Ap)	Lecture with illustration, Peer tutoring	Slip Test
	4	Transcendence of e, Problems	5	K5 (E)	Problem solving	Brainstorming
II						
	1	Definition- roots of polynomials, multiplicity of roots, Remainder theorem	3	K1 (R)	Lecture using videos	Evaluation through short test
	2	Theorems based on roots of polynomials,	4	K2 (U)	Flipped classroom	concept definitions, concept with examples

		Existence theorem of splitting fields				
	3	Theorems based on isomorphism of fields, Theorems based on splitting field of polynomials	4	K2 (U)	Blended learning	Quiz using Nearpod
	4	Uniqueness theorem of splitting fields	3	K3 (An)	Context based	Slip Test, Quiz using gooogle forms
	5	Definition- derivative of polynomials, Simple extension, Theorems on simple extension	4	K3 (Ap)	Reflective Thinking	Brainstorming
III						
	1	Definition -Fixed Field, Group of automorphism,	4	K2 (U)	Demonstrative	concept with examples, Questioning
	2	Theorems on Fixed Field, Theorems on Fixed Field	4	K2 (U)	Lecture Method	Evaluation through short test
	3	Theorems on Group of Automorphism, Theorems on Normal Extension	5	K3 (Ap)	PPT	Group discussion
	4	Theorems on Galois Group, Construct theorems on Normal Extension and Galois Group, Problems	5	K5 (E)	Problem solving	concept explanations
IV						
	1	Definition -Finite Fields, Characteristic of F with examples	4	K4 (An)	Introductory session	concept with examples, Assignment

	2	Theorems based on Finite Fields and Characteristic of F	5	K2 (U)	Context based	concept explanations, Quiz using Slido
	3	Finite field and Cyclic group	5	K4 (An)	Brainstorming	concept explanations, Evaluation through short test
	4	Wedderburn's Theorem on finite division ring	4	K3 (Ap)	Lecture Method	Group discussion
V						
	1	Solvability by radicals – Introduction, Solvable and Commutator group	3	K2 (U)	Lecture Method	concept with examples
	2	Lemma and Theorem based on solvable by radicals, General polynomial definition and theorem	3	K2 (U)	Demonstrative	Group discussion
	3	Definitions -algebraic over F and Frobenius theorem	4	K3 (Ap)	Demonstrative	Seminar
	4	Internal quaternions and Lagrange identity	4	K4 (An)	Computational thinking	Evaluation through short test
	5	Left-Division algorithm, Four-Square Theorem	4	K2 (U)	Lecture Method	Quiz using Mentimeter

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

Activities (Em/ En/SD): Solve practical problems in networking and communication

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

Activities related to Cross Cutting Issues: Nil

Assignment: Finite Fields

Seminar Topic: Frobenius theorem

Sample questions

Part A

1. Name the complex number which is not algebraic.
   a) algebraic b) transcendental c) rational d) algebraic integer
2. Identify the condition: The element $a \in K$ is a root of $p(x) \in F[x]$ of multiplicity m if $(x-a)^m \mid p(x)$ whereas
   a) $(x-a)^{m+1} \mid p(x)$ b) $(x-a)^{m+1} \nmid p(x)$ c) $(x-a)^{m+1} \mid p(x)+1$ d) $(x-a)^{m+1} \nmid p(x)+1$
3. Complete: K is a ____________ of F if K is a finite extension of F such that F is the fixed field of G(K, F).
4. Name the fields having only a finite number of elements

   a) finite fields b) infinite fields c) splitting fields d) commutative field
5. Say True or False: Every polynomial of degree n over the field of complex numbers has all its n roots in the field of real numbers.

Part B

1. If L is an algebraic extension of K and if K is an algebraic extension of F then L is an algebraic extension of F.
2. If F is a field of characteristic $p \neq 0$, then prove that the polynomial $x^{p^n} - x \in F[x]$, for $n \geq 1$, has distinct roots.
3. If K is a finite Extension of F, then prove that G(K,F) is a finite group and its order, o(G(K,F)) satisfies o(G(K,F)) ≤ [K:F].
4. Prove that any two finite fields having the same number of elements are isomorphic.
5. Let C be the field of complex numbers and suppose that the division ring D is algebraic over C. Then prove that D = C.

Part C

1. Prove that the number e is transcendental.
2. Prove that any two splitting fields of the same polynomial over a given field F are isomorphic by an isomorphism leaving every element of F fixed.
3. State and prove fundamental theorem of Galois theory.
4. Prove that a finite division ring is necessarily a commutative field.
5. Prove that every positive integer can be expressed as the sum of squares of four integers.

Head of the Department **Course Instructor**

Dr.J.Anne Mary Leema **Dr.C.Jenila**

Real Analysis II

Department : **Mathematics (S.F)**
Class : **I M.Sc. Mathematics**
Title of the Course : **Core Course V: Real Analysis II**
Semester : **I**
Course Code : **MP232CC2**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP231CC2	5	1	-	-	4	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

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	recall and describe the basic concepts of measure, integration of functions, Fourier series on real line and multivariable differential calculus, implicit functions and extremism problems.	PSO - 1	K1 &K2
CO - 2	compare Boral measure with Lebesgue measure and the total derivatives with partial derivatives.	PSO - 2	K3
CO - 3	determine the matrix representation and Jacobian determinant of functions.	PSO - 1	K3
CO - 4	analyze the properties of measurable functions, Riemann and Lebesgue Integrals, convergence of Fourier series and extrema of real valued functions.	PSO - 2	K4
CO-5	test measurable sets and measurable functions.	PSO - 2	K5

Total contact hours: 75 (Including instruction hours, assignments and tests)						
Unit	**Module**	**Topic**	**Teaching Hours**	**Cognitive level**	**Pedagogy**	**Assessment/ Evaluation**
I	**Lebesgue Measure**					
	1.	Introduction - Outer Measure	2	K_1, K_2	Lecture with illustration	Questioning
	2.	Measurable sets and Lebesgue measure–A non measurable set	5	K_1, K_2	Interactive PPT	Short test
	3.	Borel and Lebesgue Measurability	5	K3	Lecture method	Class test
II	**The Lebesgue Integral**					
	1.	Riemann Integrals	2	K2	Brainstorming	Assignment
	2.	The Lebesgue integral of a bounded function over a set of finite measure	5	K2, K3	Flipped classroom	Online Quiz using Quizziz
	3.	The integral of a nonnegative function - The general Lebesgue integral.	5	K4	Collaborative learning	Differentiate between Riemann and Lebesgue Integrals
III	**Fourier Series and Fourier Integrals**					
	1.	Introduction - Orthogonal system of functions - The theorem on best approximation	4	K2	Brainstorming	Quiz using Slido
	2.	The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer theorem	5	K2, K4	Lecture with illustration	Solving Exercise Problems
	3.	The convergence and representation problems for trigonometric series - The Riemann-Lebesgue lemma - The Dirichlet integrals - An integral representation for the partial sums of Fourier series	5	K2, K4	Blended Classroom	Explaining the steps of the theorems
	4.	Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –	4	K4	Seminar Presentation	Questioning

	5.	Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem.	4	K4	Seminar Presentation	Class Test
IV	**Multivariable Differential Calculus**					
	1.	Introduction - The directional derivative - Directional derivative and continuity	3	K1 & K2	Interactive PPT	Quiz using Slido
	2.	The total derivative - The total derivative expressed in terms of partial derivatives	3	K3	Lecture with chalk and talk	Problem Solving
	3.	The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule	3	K3	Blended Classroom	Questioning
	4.	The mean-value theorem for differentiable functions - A sufficient condition for differentiability	3	K2	Seminar Presentation	Short test
	5.	A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1	3	K3, K4	Seminar Presentation	Slip Test
V	**Implicit Functions and Extremum Problems**					
	1.	Introduction - Functions with non-zero Jacobian determinants – The inverse function theorem	4	K3	PPT using Gamma AI	Q & A
	2.	The implicit function theorem	3	K2, K4	Flipped Classroom	Concept explanations
	3.	Extrema of real valued functions of one variable	3	K2, K4	Seminar Presentation	Questioning
	4.	Extrema of real-valued functions of severable variables-Extremum problems with side conditions.	4	K4	Seminar Presentation	Slip test

Course Focussing on: **Skill Development**

Activities (Em/ En/SD): Problem-solving, Seminar Presentation, Quiz Competition

Assignment: Solving Exercise Problems

Seminar Topic: Fourier Series and Fourier Integrals, Multivariable Differential Calculus
Sample Questions:

Part A

1.Say true or false: Union of two measurable sets is measurable.
2. Say true or false: Every step function is a simple function.

3.The length of the vector $\bar{x} = (x_1, x_2, \dots, x_n)$ in $R^n$is ________

4.If $u = u_k$, the kth unit coordinate vector, then $\boldsymbol{f'}(\boldsymbol{c}, \boldsymbol{u_k})$ is called a _________.

5.If a function **f** has continuous partial derivatives on a set S, we say that **f** is _________on S.

Part B

1.Prove that every Borel Set is measurable.
2.If f is bounded and Riemann integrable on$[a, b]$ then prove that it is measurable and **R**$\int_a^b f\,dx = \int_a^b f\,dx$.
3.State and prove Bessel's inequality.
4.Assume **f** is differentiable at **c** with total derivative $\boldsymbol{T_c}$**.** Then prove that the directional derivative $\boldsymbol{f'}(\boldsymbol{c}; \boldsymbol{u})$ exists for every **u** in R^n and we have $\boldsymbol{T_c}(\boldsymbol{u}) = f'(c; u)$.
5.Let A be an open subset of R^n and assume that $f: A \to R^n$ has continuous partial derivatives $D_i f_i$ on A. If $J_f(\boldsymbol{x}) \neq 0$ for all **x** in A, then prove that **f** is an open mapping.

Part C

1.Prove that outer measure of an interval equals its length.
2.State and prove (i) Lebesgue's Convergence Theorem and (ii) Fatou's Lemma.
3. Let $\{\varphi_0, \varphi_1, \varphi_2, \dots\}$ be orthonormal on I, and assume that $f \in L^2(I)$. Define two sequences of functions $\{s_n\}$ and $\{t_n\}$ on I as follows :$s_n(x) = \sum_{k=0}^{n} c_k \varphi_k(x)$, $t_n(x) = \sum_{k=0}^{n} b_k \varphi_k(x)$ where $c_k = (f, \varphi_k)$ for $k = 0,1,2, \dots$ and $b_0, b_1, b_2, \dots$ are arbitrary complex numbers. Then prove that for each n, we have $\|f - s_n\| \leq \|f - t_n\|$.
4.Assume that one of the partial derivatives $D_1\boldsymbol{f}, \dots, D_n f$ exists at c and that the remaining n-1 partial derivatives exist in some n-ball B(c) and are continuous at c. Then prove that **f** is differentiable at **c**.
5. State and prove Inverse function theorem.

Dr.J.Anne Mary Leema — **Head of the Department**

Dr.J.Anne Mary Leema — **Course Instructor**

Semester : **II**

Name of the Course : **Partial Differential Equations**

Course code : **MP232CC3**

Major Core : **VI**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PM2023	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

CO	Upon completion of this course the student will be able to	PSO Addressed	CL
CO-1	recall the definitions of complete integral, particular integral and singular rintegrals.	PSO-2	R
CO-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

CO-3	analyze the classification of partial differential equations in three independent variables – cauchy's problem for a second order partial differential equations.	PSO-3	An
CO-4	solve the boundary value problem for the heat equations andt he wave equation.	PSO-4	Ap
CO-5	apply the concepts and method sinphysical processes like heat transfer and electrostatics.	PSO-5	Ap

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

Unit	Module	Topics	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Non-linear Partial Differential Equations of First Order**					
	1	Introduction, Explanation of complete integral, particular integral and singular integral	2	K2(U)	Brainstorming	Questioning
	2	Explanation of terms,compactible system of first order equations,Examples related to compactible system	3	K3(Ap)	Blended Learning	Evaluation through Quiz
	3	Explaining Charpit's Method .	3	K2(U)	Lecture using videos	Evaluation through short test
	4	Problems related to charpit's method	2	K3(Ap)	Intractive method	Evaluation through MCQ
	5	Solving problems using charpit's method	3	K3(Ap)	Peer teaching, Group Discussion	Evaluation through slip test

	6	Problems related to charpit's method	3	K3(Ap)	Problem solving	Evaluation through Assignment
II	**Homogeneous Linear Partial Differential Equation with Constant Coefficient**					
	1	Homogeneous and non-homogeneous linear equation with constant coefficient, Solution of finding homogeneous equation with constant coefficient.	2	K2(U)	Blended Learning	Questioning
	2	Method of finding complementary function, Working rule for finding complementary function ,Alternative working rule for finding complementary function	2	K2(U)	Lecture using PPT	Evaluation through Assignment
	3	Some examples for finding Complementary function	3	K2(U)	Flipped classroom	Evaluation through slip Test
	4	General method and working rule for finding the particul integral of homogeneous equation and some example	3	K3(Ap)	Lecture using chalk and talk	Evaluation through MCQ
	5	Examples to find the particular integral	3	K3(Ap)	Heuristic method	Evaluation through quiz
III	**Non–homogeneous Linear Partial Differential Equations with Constant Coefficient**					
	1	Definition, Reducible and irreducible linear differential operators, Reducible and irreducible linear partial differential equations with constant coefficient, Determination of complementary function	2	K2(U)	Lecture using PPT	Questioning

	2	General solution and particular integral of non-homogeneous equation and some examples of type1	3	K2(U)	Heuristic method	Evaluation through true or false
	3	Some examples of type2	3	K3(Ap)	Interactive method	Evaluation through MCQ
	4	Some problems related to type3	3	K3(Ap)	Peer teaching, Group Discussion	Evaluation through slip test
	5	Examples related to type4, Miscellaneous examples for the determination of particular integral	4	K5(E)	Blended Learning	Evaluation through Assignment
IV	**Classification of P.D.E. Reduction to Canonical(or normal) Forms**					
	1	Classification of Partial Differential equations of second order – Classification of P.D.E. in three independent variables	2	K2(U)	Analytic method	Evaluation through quiz
	2	Cauchy's problem for a second order P.D.E. Characteristic equation and Characteristic curves of the second order P.D.E.	2	K2(U)	Lecture using PPT	Evaluation through slipTest
	3	Laplace Transformation .Reduction to Canonical(or normal) forms.(Hyperbolic type)	4	K3(Ap)	Flipped classroom	Evaluation through Assignment
	4	Laplace Transformation ,Reduction to Canonical (or normal) forms.(Parabolic type)	4	K3(Ap)	Heuristic method	Evaluation through MCQ
	5	Laplace Transformation .Reduction to	3	K5(E)	Peer teaching, Group	Evaluation through short Test

		Canonical(or normal) forms.(Elliptic type)			Discussion	
V	**Boundary Value Problem**					
	1	A Boundary value problem, Solution by Separation of variables, Solution of one dimensional wave equation, D'Alembert's solution, Solution of two dimensional wave equation	3	K2(U)	Interactive method	Evaluation through Quiz
	2	Vibration of a circularmembrane, Examples related to vibration of a circularmembrane	4	K3(Ap)	Lecture using PPT	Evaluation through slipTest
	3	Solution of one dimensional heat equation, Problems related to solution of one dimensional heat equation	4	K2(U)	Blended Learning	Questioning
	4	Solution of two dimensional Laplace's equation	3	K5(E)	Peer teaching, Group Discussion	Evaluation through quiz
	5	Solution of two dimensional heat equation	3	K3(Ap)	Analytic method	Evaluation through Assignment

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

Activities (Em/ En/SD): Solving the Problems, Group discussion, Seminar, Online Assignment

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

Activities related to Cross Cutting Issues: Nil

Assignment : Cauchy's problem for a second order P.D.E.

Characteristic equation and Characteristic curves of the second order P.D.E, Solution of two dimensional heat equation.

Seminar Topic: Laplace
Transformation ,Reduction to Canonical (or normal) forms.(Parabolic type)

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. Find a complete integral of px+ qy = pq

2. Solve $(D^2+DD'-6D'^2)z = y \sin x$

3. Solve $(D^2 –DD' – 2D'^2 +2D +2D')z = \sin (2x +y)$

4. Find the characteristics of 4r + 5s + t + p + q – 2 = 0.

5. Obtain the steady state temperature distribution in a rectangular metal plate of length a and width b ,the sides of which are kept at temperature 0^0C the lower edge is kept at 100^0 C and the upper edge kept insulated.

PART-C

1. Show that the equations f(x,y,p,q) =0 , g((x,y,p,q) =0 are compatible if $\frac{\partial(f,g)}{\partial(x,p)} + \frac{\partial(f,g)}{\partial(y,q)} = 0$ .Verify that the equations p = P(x,y),q = Q(x,y) are Compatible if $\frac{\partial P}{\partial y} = \frac{\partial Q}{\partial x}$

2. Solve $r – t = \tan^3 x \tan y – \tan x \tan^3 y$

3. Solve $(D^2-DD'-2D)z = \sin(3x+4y) + x^2 y$

4. Reduce the equation $\frac{\partial^2 z}{\partial x^2} + 2\frac{\partial^2 z}{\partial x \partial y} + \frac{\partial^2 z}{\partial y^2} = 0$ to canonical form and hence solve it.

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 are kept at zero temperature .Determine the temperature at a point of the plate as t increases.

Head of the Department **Course Instructor**

Dr. J. Nesa Golden Flower

Mathematical Statistics

Class : I M. Sc Mathematics
Title of the Course : Elective Course III: a) Mathematical Statistics
Semester : II
Course Code : MP232EC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP232EC1	3	1	-	3	4	60	25	75	100

Objectives

1. To enhance knowledge in mathematical statistics and acquire basic knowledge about various distributions.
2. To understand about mathematical expectations, moment generating function technique and the Central Limit Theorem.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO – 1	recall the basic probability axioms, conditional probability, random variables and related concepts	PSO – 1	**K1**
CO – 2	learn the transformation technique for finding the p.d.f of functions of random variables and use these techniques to solve related problems	PSO – 3	**K2**
CO – 3	compute marginal and conditional distributions and check the stochastic independence	PSO – 4	**K3**
CO – 4	employ the relevant concepts of analysis to determine limiting distributions of random variables	PSO – 3	**K2**
CO – 5	design probability models to deal with real world problems and solve problems involving probabilistic situations	PSO – 5	**K3**

Teaching plan

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

Unit	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I					
	Introduction to Statistics	1	K1(U)	Introductory session	Simple definitions
	Sampling Theory	3	K2(R)	Lecture using Chalk and talk	Diagnostic test
	Transformations of Variables of the Discrete Type	2	K2(U)	Problem solving	Class Test
	Transformations of Variables of the Continuous Type	4	K2(U)	Interactive PPT	Quiz
	The t and F Distributions	2	K2(U)	Computational Thinking	Problem Solving
II					
	Limiting Distributions	3	K1(U)	Lecture using Chalk and talk	Evaluation through short test
	Stochastic Convergence	3	K2(U)	Lecture	Map knowledge
	Limiting Moment Generating Functions	3	K3(A)	Problem Solving	Practical Exercises

	The Central Limit Theorem	3	K2(U)	Lecture	Class Test
III					
	Point Estimation	3	K2(U)	PPT	Short essays
	Measures of Quality of Estimators	2	K3(Ap)	Project Based	MCQ Using Slido
	Confidence Intervals for Means	3	K4(An)	Flipped Classroom	MCQ Using Nearpod
	Confidence Interval for Difference of Means	2	K4(An)	Problem Solving	Slip test
	Confidence Interval for Variances	2	K3(A)	Blended Learning	MCQ Using Nearpod
IV					
	Statistical Hypothesis	3	K2(U)	Context Based	Short summary
	Certain Best Tests	3	K4(An)	Lecture Method	Short Summary
	Uniformly Most Powerful Tests	3	K3(A)	Problem Solving	Problems to Solve
	Likelihood Ratio Tests	3	K3(A)	Project Based	Seminar
V					
	Chi-Square Tests	3	K4(An)	Demonstration	Problems to Solve
	The Distributions of Certain Quadratic Forms	3	K3(A)	Lecture	Evaluation through problems

	A Test of Equality of Several Means	3	K3(A)	Problem solving	Recall Steps
	Noncentral χ^2 and Noncentral F	3	K4(An)	Lecture method	MCQ

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

Activities (Em/ En/SD): Solving the Problems, Group discussion, Seminar, Online Assignment, Peer Teaching.

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

Activities related to Cross Cutting Issues: Nil

Assignment: Chi-Square Tests, Noncentral χ^2 and Noncentral F

Seminar Topic: Best Tests, Ratio Test

Sample questions (minimum one question from each unit)

Part A

1. A function of one or more random variables that does not depend on one or more parameter is called….

A. Static B. Dynamic C. Statistic D. Continuous

2. Which of the following best describes limiting distributions?

A. The probability distribution of a random variable at a fixed point.
B. The distribution of a sequence of random variables as they converge.
C. The distribution of independent random variables.
D. The variance of a random variable as it approaches infinity.

3. What does "point estimation" in statistics refer to?

A. Estimating a range of values for a population parameter

B. Estimating the standard deviation of a sample

C. Estimating a single value for a population parameter

D. Estimating the probability of an event

4. If C is a subset of a sample space that leads to a rejection of hypothesis, then C is called

A. Critical region B. Power Set C. False region D. Discontinuous

5. A homogenous polynomial of degree 2 in n variables is called

A. bilinear form B. Quadratic form

C. Normal D. Monic Polynomial

Part B

1. Explain Transformation of variable of discrete type.

2. Let $F_n(u)$ denote the distribution function of a random variable U_n whose distribution depends up on the positive integer n. Also let U_n converges stochastically to the positive constant c and let Pr $(U_n < 0 = 0$ for every n. Then prove that the random variable $\sqrt{U_n}$ converges stochastically to $\sqrt{c}$.

3. Explain confidence intervals foe means.

4. Test the hypothesis $H_0: f(x) = \begin{matrix} \frac{e^{-1}}{x!}, & x = 0,1,2,\dots \\ 0 & elsewhere \end{matrix}$ against the alternative simple hypothesis $H_1: f(x) = \begin{matrix} \left(\frac{1}{2}\right)^{x+1}, & x = 0,1,2,\dots \\ 0 & elsewhere \end{matrix}$.where $X_1, X_2, \dots X_n$ denote a random sample from a distribution which has a p.d.f $f(x)$ that is positive on non-negative integers.

5. Explain Chi-Square test.

Part C

1. Discuss t and f distribution.

2. State and prove Central Limit Theorem.

3. Explain confidence intervals for variance.

4.State and prove Neyman-Pearson Theorem.

5. Explain Noncentral λ^2 and Noncentral F.

Head of the Department Course Instructor

Dr. J. Anne Mary Leema **Dr. B. ShekinahHenry**

Department : **Mathematics (S.F)**
Class : **I M.Sc**

Semester : **II**

Name of the Course : **Operations Modelling**

Course Code : **MP232EC4**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP232EC4	3	1	-	-	3	4	60	25	75	100

Learning Objectives

1. To analyze different situations in the industrial/ business scenario involving limited resources
2. To finding the optimal solution within constraints.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	
1.	Build and solve Transportation and Assignment problems using appropriatemethod	PSO - 2	K_1(R)
2.	Learn the constructions of network and optimal scheduling using CPM and PERT	PSO - 3	K_2(U)
3.	Ability to construct linear integer programming models and solve linear integerprogramming models using branch and bound method	PSO - 3	K_5(E)
4.	Understand the need of inventory management.	PSO - 4	K_4(An)
5.	To understand basic characteristic features of a queuing system and acquire skills in analyzing queuing models	PSO - 1	K_3(Ap)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Transportation Models and its Variants**					
	1.	Transportation Models and its Variants	2	K1 & K2	Brainstorming	Questioning
	2.	Definition of the Transportation Model –	2	K3	Lecture with illustration	Short Test
	3.	Non-Traditional Transportation Mode	3	K1 & K3	Problem Solving	Quiz using Quizizz
	4.	Transportation Algorithm, The Assignment Model	3	K5	Lecture with Illustration	Class test
	5.	Transportation Algorithm – The Assignment Model	2	K4	Collaborative learning	Assignment
II	**Network Analysis**					
	1.	Network Analysis	2	K1	Lecture with illustration	Questioning
	2.	Minimal Spanning Tree Algorithm	3	K3	Lecture Discussion	Short summary of the algorithm
	3.	Shortest Route Problem	2	K2 & K3	PPT using Gamma AI	Assignment
	4.	MaximumFlow Model	2	K3 & K4	Seminar Presentation	Recall steps
	5.	CPM –PERT	3	K3	Seminar Presentation	Class test
III	**Inventory Theory**					
	1.	Inventory Theory-Introduction	1	K1 & K2	Brainstorming	Quiz
	2.	Basic Elements of an Inventory Model	2	K3	Interactive PPT	Assignment

	3.	Deterministic Models	3	K4	Lecture Discussion	Short Test
	4.	Single Item Stock Model With And Without Price Breaks	3	K5	Blended Learning	Concept Explanation
	5.	Multiple Item Stock Model With And Without Price Breaks	3	K6	Collaborative learning	Peer review writing
IV	**Probabilistic Models**					
	1.	Probabilistic Models: Continuous Review Model-Single Period Models.	4	K1 & K2	Lecture with illustration	Differentiate between various modes
	2.	Continuous Review Model	4	K3 & K4	Flipped Classroom	MCQ
	3.	Single Period Models	4	K4 & K5	Problem Solving	Open book test
V	**Queuing Theory**					
	1.	Queuing Theory-Introduction	2	K1 & K2	Seminar Presentation	MCQ
	2.	Basic Elements of Queuing Model	2	K4	Seminar Presentation	Solving exercise problems
	3.	Role of Poisson and Exponential Distributions	2	K4 & K5	Seminar Presentation	Questioning
	4.	Pure Birth andDeath Models	2	K2 & K3	Seminar Presentation	Slip Test
	5.	Specialised Poisson Queues - $(M/G/1):GD/\infty/\infty)$	2	K2 & K5	Seminar Presentation	Quiz
	6.	Pollaczek - Khintechine Formula	2	K4	Seminar Presentation	Evaluation through short test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em/ En/SD): Seminar Presentation, Quiz

Assignment: Problems based on Inventory and Queuing model.

Seminar Topic: Queuing Theory

Sample questions

Part A:

1. Which is known as Knapsack problem.

   a) Principle of optimality b) flyaway kit problem c) Cargo loading problem

2. Project scheduling by PERT-CPM consists of ___________ basic phases.

   a) 2 b) 3 c) 4 d) 5

3. An ___________ in a project is usually viewed as a job requiring time and resources for its completion.

4. In a single server model(M/M/1): (GD/∞/∞), the W_q =---------------

5. The measure of L_s in machine servicing model is

   a) $L_q + \frac{\lambda_{eff}}{\mu}$ b) $L_q + \lambda_{eff}$ c) $L_q + \mu\, \lambda_{eff}$ d) $\mu + \lambda_{eff}$

Part B:

6. Find the optimal solution to the cargo loading problem.

7.Write the Formulation of CPM by linear programming approach.

8.Explain the factors which may also influence the way the inventory model is formulated.

9.Obtain the probability P_n(t) of Departure Process.

10. Explain pure birth and death process.

Part - C

11.A Contractor needs to decide on the size of his work force over the next 5weeks.He estimates the minimum force size b_i for the 5 weeks to be 5,7,8,4 and 6 workers for i=1,2,3,4 and 5 respectively. Find the optimum sizes of the work force for the 5 – week planning horizon.

12.Given the following information

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Duration	2	8	10	6	3	3	7	5	2	8

Draw the network diagram. Find critical path. Determine Total Float and free Float

13.Explain Single item static model.

14.Derive the difference- differential equations of(M/M/1): (GD/∞/∞).

15**.** Derive P.K formula

Head of the Department:

Dr. J.Anne Mary Leema

Course Instructor:

Dr. J.Anne Mary Leema

Introduction to MS Excel 2007

Department : **Mathematics**
Class : **I M.Sc.**
Title of the Course : **Introduction to MS Excel**
2007Semester : **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	Group Discussion
	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 Teaching
	5.	Closing the Current Workbook, Opening an Existing Workbook , Closing MS Excel.	3	K3	PPT	Online Assignment
II	**Working with Data and Data Tables**					
	1.	Introduction, Entering Data using AutoFill, AutoFill a Text Series, AutoFill a Number Series.	3	K2	Flipped Classroom	Group Discussion
	2.	Creating Your Own Custom List, Using Merge & Center, Turning on Text Wrapping.	3	K3	Demonstration	Group Discussion

	3.	Changing Number Formats, Increasing or decreasing decimals in Numeric Data.	3	K3	Experimental learning	Assigning Exercises
III	**Working with Data and Data Tables**					
	1.	Sorting Data, Sorting Data using Some Predefined Criteria, Sorting Data by Defining Custom Sort Criteria.	3	K3	Reflexive thinking	Discussion
	2.	Filtering Data, Linking Data, addinga Hyperlink, editing a Hyperlink, Removing a Hyperlink.	3	K3	Context based	Slip Test
	3.	Creating a Table, creating a Table froma Blank Introduction to MS Excel 2007 Cell Range, Creating a Table froman Existing Data Range.	3	K5	Project based	Assignments
	4.	Editing a Table, formatting a Table, sorting a Table, Filtering aTable	3	K3	Demonstration	Experiments
IV	**Using Formulas and Functions**					
	1.	Introduction, Understanding Formulas, Operators in Excel 2007, Operator Precedence.	3	K2	Lecture method With Illustration	Short Test
	2.	Creating a Formula, editing a Formula, Defining Range Names, Assigning a Range name, Selecting a Range, Editing a range Name.	3	K6	Experimental Learning	Assigning Exercises

	3.	Referencing Rangesin Formulas, Referencing Cells from Other Worksheets.	3	K3	Blended Learning	MCQ
	.4,	Using Relative andAbsolute Cell References, Understanding Functions, Some Common Excel Functions.	3	K3	Context based	Peer Teaching
	5.	Applying a Function, editing a Function, Calculating Total of Cell Data with AutoSum.	3	K4	Reflexive thinking	Oral Test
V	**Working with Charts**					
	1.	Introduction, creatinga chart, Changing the Chart Layout, Changing the Chart Styles.	3	K5	Experimental Learning	Presentation
	2.	Changing the Chart Type, adding a ChartTitle, Adding Axis Titles.	3	K3	Project Based	Preparation of Question Bank by students
	3.	Adding Data Labels, adding a Legend, Adding Gridlines.	3	K4	Project Based	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 formattingchallenge.

Assignment: Working with Data and Data Tables

Sample questions (minimum one question from each unit)

Part A

1. How will you save a current workbook in Excel 2007?
2. What does the Text Wrapping feature in Excel 2007 do?
3. What is a hyperlink in Excel, and how can it be used?

4. What does the AutoSum function in Excel 2007 do?
5. How do you add a chart title in Excel 2007?

Part B

1. Explain the purpose and functionality of the Ribbon in Excel 2007.
2. Describe the process of turning on Text Wrapping and its significance.
3. What are the steps to create a table from an existing data range, and what are its key features?
4. Describe the steps for creating, editing, and referencing a formula in Excel 2007.
5. Explain how to change the chart type and chart styles in Excel 2007.

Part C

1. Discuss the importance of Contextual Tabs, Dialog Box Launchers, and Super ToolTips in Excel 2007.
2. Describe in detail how to use AutoFill in Excel 2007 for text and number series. Include examples and benefits.
3. Discuss sorting and filtering data in Excel 2007. Provide steps, differences, and practical examples.
4. How does Excel 2007 facilitate data analysis using formulas, range names, and AutoSum? Provide a detailed explanation and examples.
5. How can changing chart layouts, styles, and gridlines improve data visualization in Excel 2007?

Head of the Department	**Course Instructor**
Dr. J. Anne Mary Leema	**Dr. B. ShekinahHenry**

Functional Analysis

Department : **Mathematics (SF)**
Class : **II M.Sc.**
Title of the Course : **Core X Functional Analysis**
Semester : **IV**
Course Code : **MP234CC1**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP234CC1	6	-	-	5	6	90	25	75	100

Objectives:

1. To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems.
2. To develop student's skills and confidence in mathematical analysis and proof techniques.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSOs addressed	Cognitive level
CO - 1	able to demonstrate comprehension of the definitions and basic properties of Banach and Hilbert spaces	PSO - 1	K1(R)
CO - 2	able to apply the Hahn Banach theorem to extend continuous linear functionals on subspaces to the whole space	PSO -2	K3(A)
CO - 3	describe the concept of adjoint operators in Hilbert spaces and recognize properties of self-adjoint, normal, and unitary operators	PSO - 2	K2(U)
CO - 4	analyze the concepts of determinants, spectrum, and the spectral theorem for operators in finite-dimensional spaces	PSO - 4	K4(An)
CO - 5	evaluate the structure of commutative Banach algebras, including understanding the Gelfand Mapping and applications of spectral radius formula	PSO - 1	K5(E)

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

Unit	Module	Topics	Teaching Hours	Cognitive level	Pedagogy	Assessment/ evaluation
I	**Banach Spaces**					
	1.	Introduction to Banach space	1	K1 (R)	Introductory session	Simple definitions, Recall basic concepts
	2.	Definition and, examples of normed linear space and Banach Space, theorem on Normed linear space.	2	K1 (R) K2 (U)	Interactive PPT	MCQ
	3.	Properties of a Closed unit sphere, Holder's Inequality and Minkowski's Inequality.	3	K1 (R) K2 (U)	Lecture with illustrations	Group Discussion
	4.	Continuous linear transformations, theorems on Banach Space	4	K2 (U) K3(Ap)	Flipped Classroom	Evaluation through slip test
	5.	Definition of an Operator, Hahn Banach theorem, Theorem based on functional in N*, Problems based on Normed linear spaces	5	K1 (R) K3(Ap)	Computational learning	MCQ using Nearpod
II	**Banach spaces**					
	1.	Second conjugate space, induced functional, weak	4	K1 (R)		

		topology, weak* topology, Strong topology,		K3(Ap)	Lecture using videos	Evaluation through short test
	2.	Theorem on isometric isomorphism of Open mapping theorem and Open mapping theorem	4	K2 (U) K6(C)	Blended learning	Home Assignment
	3.	Projection, Closed Graph Theorem,	4	K1 (R) K3(Ap)	Lecture with illustration.	MCQ using slido
	4.	The conjugate of an operator, the Uniform, Boundedness theorem and theorem on isometric isomorphism	3	K2 (U) K3(Ap)	Computational Learning	Online Assignment
III	**Hilbert Space**					
	1.	Hilbert Space, Properties of a Hilbert Space, Schwarz Inequality, Parallelogram law, Theorem on Convex subset of a Hilbert Space	3	K2 (U) K3(Ap)	Lecture with illustration	MCQ
	2.	Theorem on Orthogonal Complements and theorem on closed linear subspaces	3	K1 (R) K3(Ap)	Evaluative Learning	Formative Assessment Test I
	3.	Orthonormal set, Bessel's Inequality	5	K2 (U) K3(Ap)	Brain storming	Oral Test

		and Theorems on Orthonormal Sets				
	4.	Gram –Schmidt Orthogonalization Process, theorem on Conjugate Space H*	4	K1 (R) K3(Ap)	Interactive PPT	Short summary
IV	**Adjoint operator**					
	1.	Definition and small results, theorem on the properties of an adjoint operator	3	K1 (R) K4(An)	Lecture with illustration	Oral Test
	2.	Self-adjoint operator, theorems on self-adjoint operators	3	K2 (U) K4(An)	Interactive PPT Gamma AI	MCQ
	3.	Normal and Unitary Operators, theorems on Normal and Unitary Operators,	3	K1 (R) K4(An)	Blended learning	Slip Test
	4.	Projections, theorems on Projections and theorems on invariant subspace	3	K2 (U) K4(An)	Brain Storming	Online Quiz
	5.	Spectral theory, Definition of Spectrum of an operator and spectral theorem	3	K1 (R) K4(An)	Lecture using videos	Home assignment
V	**General Preliminaries on Banach Algebras**					

	1.	The definition and some examples of Banach algebra	3	K1 (R) K2 (U)	Lecture with illustration	MCQ Using Nearpod
	2.	Theorems on Regular and Singular elements	4	K1 (R) K3(Ap)	Interactive PPT using Gamma AI	Class Test
	3.	The definition and theorems on spectrum	4	K1 (R) K4(An)	Evaluative Learning	Formative Assessment Test II
	4.	The formula and theorems on Spectral radius	4	K1 (R) K4(An)	Lecture using videos	Quiz

Course Focusing on Employability/Entrepreneurship/Skill Development : Skill Development

Activities(Em/En/SD) : 1. Evaluation through short test, Quiz competition

2. Peer teaching, Puzzles

Assignment: Preparation of quiz questions, Normal and Unitary Operators

Seminar Topic: Hilbert Space and Adjoint operator

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

Activities related to Cross Cutting Issues : Nil

Sample questions: (Minimum one question from each unit)

Part-A

1. Which of the following is not a property of norm in general?
   (a) $\|x\| \geq 0$
   (b) $\|x + y\| \leq \|x\| + \|y\|$
   (c) $\|kx\| = k\|x\|$
   (d) $\|x\| = 0$ iff $x = 0$
2. State the condition for a normed linear space N to be reflexive.

3.Consider the statements:

(i) A one-to-one linear transformation T of a Banach space onto itself is continuous then its inverse T^{-1} is automatically continuous.

(ii) A non-empty subset X of an normed linear space N is bounded iff f(x) is a bounded set of number for each f in N^*

a. Only (i) is true

b. Only (ii) is true

c. Both (i) and (ii) are true

d. Neither (i) nor (ii) are true.

4. 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) $\sqrt{2}$

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

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

6. Give an example of a Banach Algebra

Part-B

1. For $1 \leq p \leq \infty$, prove that $l_p{}^n$ is a Banach space.
2. If P is a projection on a Banach space B and if M and N are its range and null space, then show that M and N are closed linear subspaces of B such that $B = M \oplus N$.
3. State and prove Schwartz inequality.
4. Show that if T is normal then each M_i reduces T.
5. State and prove closed graph theorem.
6. Prove that $\sigma(x)$ is non-empty.

Part-C

1.If T is a linear transformation of N in to N^1. Then the following conditions on T are all equivalent to one another.

(i) T is continuous

(ii) T is continuous at the origin

(iii) there exists a real number $K \geq 0$ with the property that $\|T(x)\| \leq K\|x\|$ for every $x \in N$.

(iv) If $S = \{x : \|x\| \leq 1\}$ is the closed unit sphere in N then its image T(S) is a bounded set in N.'

2.State and prove the open mapping theorem.

3. State and prove Bessel's inequality

4. State and prove the Uniform Boundedness Theorem

5. State and prove the spectral theorem.

6. Prove that r(x) = lim$\|x^n\|^{1/n}$

Head of the Department
Dr. J. Anne Mary Leema

Course Instructor
Dr. B. ShekinahHenry

Teaching Plan

Department : Mathematics (SF)
Class : II M.Sc. Mathematics (SF)
Title of the Course : Core XI: Probability Theory
Semester : IV
Course Code : MP234CC2

Course Code	L	T	P	S	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

CO	Upon completion of this course, the students will be able to:	Cognitive level
CO-1	recall the basic probability axioms, conditional probability, random variables, and related concepts	K1 (R)
CO-2	define Special Mathematical Expectations, The Binomial Distribution, and The Poisson Distribution.	K2 (U)
CO-3	define The Exponential, Gamma, and Chi-square Distributions, The Normal Distribution.	K2 (U)
CO-4	study Bivariate Distributions of discrete, and continuous types, The correlation coefficient, Conditional Distribution, and The Bivariate Normal Distribution.	K5 (E)
CO-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 (Ap) K4 (An)

Teaching plan

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

Unit	Module	Topics	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Probability**					
	1	Properties of probability	4	K1 (R)	Introductory session, Lecture with illustration	Questioning, recall steps, concept definitions, concept with examples
	2	Methods of enumeration	5	K2 (U)	Group discussion, Lecture with illustration, Problem solving	Evaluation through short test, concept explanations, solve problems
	3	Conditional probability	4	K2 (U)	Lecture with illustration, Peer tutoring	Slip Test, concept explanations
	4	Independence events - Baye's theorem	5	K2 (U)	Lecture with illustration, PPT, Problem solving	Quiz using slido, concept explanations, solve problems
II	**Discrete Distributions**					
	1	Random variables of the discrete type	4	K2 (U)	Introductory session, Lecture with illustration, Problem solving	Recall steps, questioning, concept definitions, concept with examples, solve problems
	2	Mathematical Expectation - Special Mathematical Expectation	4	K2 (U)	Lecture with illustration, Group discussion	Group discussion, concept explanations, Quiz using Nearpod

	3	Binomial Distribution	5	K2 (U)	Lecture with illustration	concept definitions, concept with examples
	4	Poisson Distribution	5	K2 (U)	Lecture with illustration, Problem solving	concept definitions, concept with examples, oral test, solve problems
III	**Continuous Distributions**					
	1	Random variables of continuous type	5	K2 (U)	Lecture with illustration	concept definitions, concept with examples, questioning, Group discussion
	2	Exponential, Gamma, and Chi-square distributions	7	K2 (U)	Lecture with illustration, Peer tutoring, problem solving	concept explanations, evaluation through short test, solve problems
	3	Normal Distribution	6	K2 (U)	Lecture with illustration, Group discussion	concept definitions, concept explanations, Quiz using Mentimeter
IV	**Bivariate Distributions**					
	1	Bivariate Distributions of discrete type	4	K5 (E)	Lecture with illustration	concept definitions, concept with examples, Assignment
	2	Correlation coefficient - Conditional distribution	5	K5 (E)	Lecture with illustration, Peer tutoring, problem solving	concept explanations, Quiz using Kahoot, solve problems

	3	Bivariate distributions of continuous type	4	K5 (E)	Lecture with illustration	concept explanations, Evaluation through short test
	4	Bivariate Normal Distribution	5	K5 (E)	Lecture with illustration, Group discussion	concept definitions, concept explanations
V	**Distributions of functions of Random variables**					
	1	Functions of one random variable	4	K3 (Ap)	Introductory session, Lecture with illustration	concept explanations, concept definitions, concept with examples
	2	Transformations of two random variable - Several random variables	4	K3 (Ap)	Lecture with illustration	concept definitions, concept explanations, slip test, seminar
	3	Central limit theorem - Chebyshve's inequality and convergence in probability	5	K4 (An)	Lecture with illustration, problem solving	concept explanations, Quiz using Quizizz, solve problems
	4	Limiting moment generating functions	5	K4 (An)	Lecture with illustration	concept definitions, Evaluation through short test

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

Activities (Em/ En/SD): Group discussion

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

Activities related to Cross Cutting Issues: Nil

Assignment: Bivariate Distributions of discrete type

Seminar Topic: Transformations of two random variable, several random variables

Sample questions

Part A

1. Events A and B are ____________ if and only if $P(A \cap B) = P(A)P(B)$.
   (a) dependent (b) independent (c) enumeration (d) permutation
2. State True or False: A Bernoulli experiment is a random experiment, the outcome of which can be classified in one of two mutually exclusive and exhaustive ways.
3. Complete: The gamma function is defined by ___________.
4. State True or False: $0 \leq f(x, y) \leq 1$.
5. Complete: The mathematical expectation (or expected value) of $u(X_1, X_2, \ldots, X_n)$ is given by __________.

Part B

1. If A, B, and C are any three events, then prove that $P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B)$
2. Let X have a Poisson distribution with a mean of $\lambda = 5$. Find $P(X \leq 6)$, $P(X > 5)$ and $P(X = 6)$.
3. Find the moment generating function of exponential distribution.
4. Let the joint pmf of X and Y be defined by $f(x, y) = \frac{xy^2}{13}, (x, y) = (1,1), (1,2), (2,2)$. Find the pmf of X and Y.
5. Say $X_1, X_2, \ldots, X_n$ are independent random variables and $Y = u_1(X_1)\, u_2(X_2) \ldots u_n(X_n)$. If $E[u_i(X_i)]$, $i = 1, 2, \ldots, n$, exist, then prove that $E(Y) = E[u_1(X_1)\, u_2(X_2) \ldots u_n(X_n)] = E[u_1(X_1)]E[u_2(X_2)] \ldots E[u_n(X_n)]$.

Part C

1. Prove that (a) $P(A|B) \geq 0$;
   (a) $P(B|B) = 1$;
   (c) If $A_1, A_2, A_3, \ldots$ are mutually exclusive events, then $P(A_1 \cup A_2 \cup \cdot\cdot\cdot \cup A_k |B) = P(A_1 |B) + P(A_2 |B) + \cdot\cdot\cdot + P(A_k |B)$, for each positive integer k, and
   $P(A1 \cup A2 \cup \cdot\cdot\cdot |B) = P(A1 |B) + P(A2 |B) + \cdot\cdot\cdot$, for an infinite, but countable, number of events.

2. (a) If c is a constant, then prove that $E(c) = c$.
   (b) If c is a constant and u is a function, then prove that $E[cu(X)] = cE[u(X)]$.
   (c) If c_1 and c_2 are constants and u_1 and u_2 are functions, then prove that
   $E[c_1u_1(X) + c_2u_2(X)] = c_1E[u_1(X)] + c_2E[u_2(X)]$.
3. If the random variable X is $N(\mu, \sigma^2)$, $\sigma^2 > 0$, then prove that the random variable $V = \frac{(x-\mu)^2}{\sigma^2} = Z^2$ is $\chi^2(1)$.
4. If X and Y have a bivariate normal distribution with correlation coefficient ρ, then X and Y are independent if and only if $\rho = 0$.
5. State and prove Central limit theorem.

Head of the Department **Course Instructor**

Dr.J.Anne Mary Leema **Dr.C.Jenila**

TEACHING PLAN

Department: Mathematics(S.F)

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	4	K_2(U)	Introductory session, Group Discussion. PPT.	Evaluation through MCQ, True/False.
	2.	Newton-Raphson Method-Ramanujan's Method	4	K_3(Ap)	Blended Learning	Simple definitions, Recall steps,
	3.	Secant Method - Muller's Method.	4	K_3(Ap)	Interactive Method	Slip test
II	1.	Differences of a polynomial - Newton's formulae for Interpolation - Central Difference Interpolation formulae	3	K_2(U)	Inductive Learning	MCQ, True/False.
	2.	Gauss's central difference formulae - Stirling's formula - Bessel's formula	5	K_2(U)	Group Peer tutoring.	Evaluation through short tests.
	3.	Everett's formula - Relation between Bessel's and Everett's formulae - Practical Interpolation.	4	K_3(Ap)	Flipped Classroom	Presentations
III	1.	Least squares and Fourier Transforms - Introduction - Least squares Curve Fitting	5	K_2(U)	Analytic Method	Evaluation through short tests.
	2.	Procedure Fitting a straight line - Multiple Linear Least squares	5	K_2(U)	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)	Flipped class room	Concept explanation
	3.	Necessity for Pivoting - Gauss - Jordan method - Modification of the Gauss method to compute the inverse	4	K_3(Ap)	Group Discussion.	MCQ, True/False.
	4.	LU Decomposition method - Solution of Linear systems - Iterative methods.	4	K_4(An)	Brainstorrming	Questioning.
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)	Interactive method	Seminar.
	3.	Numerical Integration – Trapezoidal Rule – Simpson's 1/3– Rule - Simpson's 3/8– Rule.	5	K_4(An)	Analytic Method	Concept explanations, Seminar.

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

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): Nil

Activities related to Cross Cutting Issues:Nil

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)

Part A

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

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

3.Say True or False:" The given data may not always follow a linear relationship"

4. Define the norm of a vector.

5. The Second order Runge – Kutta formula is -------

Part B

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

2. Derive the relation between Bessel's formula and Everett's formula.

3. 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)

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

5. Derive Trapezoidal rule.

Part C

1. Use the Iterative method to find the real root of the equationsin x = 10(x-1). Correct to three decimal places.

2. Derive Bessel's formula.

3. Explain Linearization of Non linear laws with example.

4. Derive a LU decomposition of a matrix.

5. Derive Simpson's 3/8 th rule.

Head of the Department **Course Instructor**

Dr. J. Anne Mary Leema **Dr. J. Nesa Golden Flower**

Network Security and Cryptography

Class : II M.Sc. Mathematics

Title of the Course : Elective Course VI: a) Network Security and Cryptography

Semester : IV

Course code : MP234EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP234EC1	4	-	-	-	3	4	60	25	75	100

Objectives: 1. To understand the fundamental principles and mechanisms of computer and network security, including security attacks, services, and encryption techniques.

2. To apply cryptographic protocols and techniques, such as symmetric and public-key encryption, message authentication codes, and user authentication protocols, to design and implement secure communication systems and protocols.

Course Outcomes

CO	Upon completion of this course the students will be able to	PSO addressed	CL
CO - 1	demonstrate proficiency in employing classical encryption techniques, including symmetric cipher models, substitution techniques, and transposition techniques, to secure data transmission and storage.	PSO - 1	K3, K4
CO - 2	design and implement message authentication mechanisms to verify the integrity and authenticity of transmitted data.	PSO - 2	K3, K6
CO - 3	analyze and identify various security attacks and vulnerabilities in computer and network systems.	PSO - 2	K4
CO -4	evaluate the principles and algorithms of public-key cryptography for ensuring confidentiality, integrity, and authenticity in communication channels.	PSO - 3	K5

CO - 5	develop expertise in deploying user authentication protocols to authenticate remote users securely and manage access control in networked environments.	PSO - 4	K6

Total contact hours: 45 (Including assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment Evaluation
I	**Computer and Network Security Concepts:**					
	1.	Computer Security Concepts, Security Attacks	3	K2, K4	Lecture with Illustration	Questioning
	2.	Security Services, Security Mechanisms	2	K2	Lecture	Quiz using slido
	3.	Symmetric Cipher Model	3	K2, K4	PPT	Problem Solving
	4.	Substitution Techniques -	3	K2, K4	PPT	Assignment – exercise problems
	5.	Transposition Techniques.	1	K4	Lecture	Slip test
II	**Public-Key Cryptography and RSA**					
	1.	Principles of Public-key Cryptosystems	3	K3, K4	Lecture	Q & A
	2.	The RSA Algorithms	2	K3, K4	Lecture using PPT	Questioning
	3.	Diffie-Hellman Key Exchange, Elliptic Curve Cryptography	2	K2, K4	Lecture with Illustration	Problem Solving
	4.	Applications of Cryptographic Hash Functions, Two Simple Hash Functions,	2	K4	Lecture with Illustration	Assignment – exercise problems

		Requirements and Security				
	5.	Hash Functions Based on Cipher Block Chaining	1	K4	Lecture	Slip test
	6.	Secure Hash Algorithm – SHA-3.	2	K4	Lecture with Illustration	Q & A
III	**Message Authentication Codes**					
	1.	Message Authentication Requirements	1	K2, K4	Lecture	Multiple choice questions using nearpod
	2.	Message Authentication Functions, Requirements for Message Authentication Codes	3	K2, K4	Lecture	Assignment – Solving Exercise problems
	3.	Security of MACs, MACs Based on Hash Functions	3	K2, K4	Lecture with illustration	Short test
	4.	MACs Based on Block Ciphers: DAA and CMAC	3	K4	PPT	Assignment
	5.	Digital Signatures	2	K2	PPT	Quiz
IV	**User Authentication**					
	1.	Remote User Authentications Principles	1	K4, K5	Lecture	Problem solving
	2.	Remote User Authentication using Symmetric Encryptions	1	K4, K5	Lecture	Q&A
	3.	Kerberos	3	K4, K5	Lecture with Illustration	Quiz
	4.	Remote User Authentication using Asymmetric Encryption	1	K4, K5	Lecture	Solving Exercise problems
	5.	Electronic Mail Security, Pretty Good Privacy	2	K4, K5	PPT	Solving Exercise problems

	6.	S/MIME	2	K2	Lecture	Questioning
	7.	Domain Keys Identified Mail.	2	K4	Lecture with illustration	Slip Test
V	**Transport-Level Security**					
	1.	Web Security Considerations	2	K2	Lecture with Illustration	Short test
	2.	Transport Layer Security	2	K2	Seminar presentation	Quiz using slido
	3.	HTTPS, Secure Shell	3	K4	Seminar presentation	Short test
	4.	Wireless Security	3	K6	Seminar presentation	Explain concepts
	5.	Mobile Device Security	2	K2	Seminar presentation	Questioning

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (Em/ En/SD): Problem-solving, Seminar Presentation, Quiz Competition

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

Activities related to Cross Cutting Issues: -Nil

Assignment: Electronic Mail Security

Seminar Topic: Remote User Authentication using Symmetric Encryptions, Remote User Authentication using Asymmetric Encryption, Domain Keys Identified Mail

Sample Questions:

Part A

1. What is the primary goal of security services in computer security?

    a) To define encryption standards.

    b) To detect and prevent unauthorized access.

    c) To provide confidentiality, integrity, and availability.

d) To develop new cryptographic algorithms.

2. Which of the following is true about Diffie-Hellman Key Exchange?

   a) It provides confidentiality for messages.

   b) It allows two parties to securely exchange a symmetric key.

   c) It uses elliptic curves for encryption.

   d) It is a symmetric key cryptosystem.

3. CMAC (Cipher-based Message Authentication Code) is based on which cryptographic primitive?

   a) Public-key cryptography   b) Symmetric block ciphers
   c) Asymmetric encryption algorithms   d) Hash functions

4. A MAC based on a hash function is commonly referred to as:
   a) HMAC   b) CMAC   c) CBC-MAC   d) SHA-MAC

5. The primary goal of DomainKeys Identified Mail (DKIM) is:
   a) Encrypting email content
   b) Verifying the sender's domain using digital signatures
   c) Blocking spam emails
   d) Providing email confidentiality

Part –B

1. Explain about Security attacks?

2. Explain the basic structure of RSA and outline the steps for key generation, encryption, and decryption.

3. What are the differences between MACs based on hash functions (HMAC) and MACs based on block ciphers (CMAC)?

4 What are the main features of Pretty Good Privacy (PGP) in ensuring email security?.

5. What are the key features of Transport Layer Security (TLS) and how does it secure communication over the web?

Part –C

1. Discuss classical encryption techniques in detail, including substitution and transposition techniques.

2. Discuss the role and applications of cryptographic hash functions. Explain how hash functions based on cipher block chaining work with an example.

3. Describe the structure and working of HMAC. How does it ensure message authentication?

4. Discuss the working of S/MIME in securing electronic mail. Highlight its advantages and limitations.

5. Explain HTTPS in detail. Discuss its architecture, working, and role in securing web communication. communication over the web?

Head of the Department | Course Instructor

Dr. J. Anne Mary Leema | **Dr. B. ShekinahHenry**

Applications of Mathematics in Artificial Intelligence

Department : **Mathematics (S.F)**
Class : **II M.Sc. Mathematics**
Title of the Course : **Elective Course VII: a) Applications ofMathematics In Artificial Intelligence**
Semester : **IV**
Course Code : **MP234EC4**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP234EC4	4	-	-	-	3	4	60	25	75	100

Learning Objectives:

1. Understand the fundamental mathematical concepts essential for AI.
2. Develop the ability to apply mathematical principles and algorithms to solve realworld problems in AI.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	demonstrate proficiency in mathematical concepts as applied toAI	**K3**
2.	apply mathematical algorithms to build, train, AI models using the programming language Python	**K3**
3.	analyse and interpret the behaviour of AI models using mathematical techniques	**K4**
4.	tackle a variety of AI challenges using mathematical reasoning and analytical techniques	**K5**
5.	propose novel approaches and solutions to complex problems in AI	**K6**

K3 – Apply; **K4** - Analyse; **K5** - Evaluate; **K6** - Create

Total contact hours: 75 (Including instruction hours, assignments and tests)						
Unit	**Module**	**Topic**	**Teaching Hours**	**Cognitive level**	**Pedagogy**	**Assessment/ Evaluation**
I	**Introduction to Artificial Intelligence**					
	1.	Overview of AI concepts and applications	4	K_1, K_2	Lecture with illustration	Questioning
	2.	Role of mathematics in AI	4	K_1, K_2	Interactive PPT	Short test
II	**Linear Algebra and AI**					
	1.	Vectors and matrices	3	K2	Brainstorming	Assignment
	2.	Matrix operations and properties	3	K2, K3	Flipped classroom	Online Quiz using Quizizz
	3.	Eigen values and eigenvectors	3	K4	Collaborative learning	Open book test
	4.	Singular Value Decomposition (SVD)	3	K2, K3	Lecture with illustration	Class test
III	**Calculus for AI**					
	1.	Differentiation and gradients	4	K2	Brainstorming	Quiz using Slido
	2.	Optimization techniques	4	K2, K4	Blended Classroom	Solving Exercise Problems
	3	Gradient Descent, Stochastic Gradient Descent	4	K3	Collaborati ve learning	Slip test
	4	Calculus of variations	4	K2, K4	Blended Classroom	Assignment
IV	**Probability and Statistics for AI**					
	1.	Probability distributions	3	K1 & K2	Interactive PPT	Questioning
	2.	Bayes' Theorem and conditional probability	3	K3	Lecture with illustration	Assignment
	3.	Expectation, variance, covariance	3	K3	Seminar Presentation	Quiz using Slido
	4.	Statistical inference	3	K2	Seminar Presentation	Short test
V	**Applications and Case Studies**					
	1.	Real world applications of AI with a focus on mathematical principles	6	K2, K3	PPT using Gamma AI	Q & A

	2.	Case studies and projects	6	K2, K4	Flipped Classroom	Concept explanations

Course Focussing on: Employability

Activities (Em/ En/SD): Problem-solving, Seminar Presentation, Quiz

Assignment: Solving Exercise Problems on Bayes' Theorem and conditional probability

Seminar Topic: Expectation, variance, covariance, Statistical inference

Sample Questions:

Part A

1. What is Artificial Intelligence (AI)?
2. Two vectors are ----------- if they point in the same direction or in the opposite direction.
3. Find the derivative of the function h(x)=$(2x+1)^4$ using chain rule.
4. The dot product is a special case of inner product.
5. Name an AI application that uses linear algebra for image processing.

Part B

1. Explain the basic difference between Artificial Intelligence and Machine Learning.
2. Prove that the system of linear equations $x_1 + x_2 + x_3 = 3$

$$x_1 - x_2 + 2x_3 = 2$$
$$2x_1 \quad + 3x_3 = 1$$

has no solution.

3. Explain gradient of vectors with respect to matrices.

4.Descirbe Expectation and covariance.

5. Explain the role of probability in AI applications like weather forecasting.

Part C

1. Discuss the key components and working of an AI system. Provide examples to illustrate each component.
2. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$.

3. Consider the function h: $R \to R$ with h(t)= (fog) (t) with f: $R^2 \to R$ and $g: R \to R^2$, $f(x) = exp(x_1 x_2{}^2), x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = g(t) = \begin{bmatrix} tcost \\ tsint \end{bmatrix}$. Find the gradient of h with respect to t.

4.State and prove Bayes' theorem.

5. Present a detailed analysis of a case study on AI in medical imaging. Explain how linear algebra and probability aid in processing and interpreting medical data.

Dr.J.Anne Mary Leema **Dr.J.Anne Mary Leema**

Head of the Department **Course Instructor**

Department : Mathematics (S.F)

Class : II M.Sc

Semester : IV

Name of the Course : Skill Enhancement Course III: Training For Competitive Examinations

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

Learning Objectives:

1. To solve problems needed for various competitive examinations.
2. To develop a comprehensive understanding of algebraic principles enablingproficient 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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Problems in metric spaces**					
	1.	Problems in metric spaces, Distance function	3	K2	Blended Classroom	Assignments
	2.	Problems in Convergence of sequences in metric spaces	3	K3	Discussion	MCQs
	3.	Problems in Cauchy sequences	3	K3&K4	Interactive examples	Class tests
	4.	Problems in Complete metric spaces	3	K3	Lecture	Quizzes
II	**Problems in metric spaces**					
	1.	Problems in connected sets	3	K2&K3	Interactive examples	Home work
	2.	Problems on Continuous functions on metric spaces, Intermediate value property	3	K4	Discussion	Short test
	3.	Problems on Heine-Borel theorem, Compact subsets in metric spaces	3	K2&K3	Lecture with illustration	Quizziz
	4.	Problems on totally bounded metric spaces	3	K3	Problem-solving	Peer review writing
III	**Problems in algebra of complex numbers**					
	1.	Problems in algebra of complex numbers, polar form	2	K3	Problem-solving	Peer group review
	2.	Problems on the complex plane -Geometric representation, Modulus-argument form	2	K3 & K4	Discussion	Worksheets

	3.	Problems on Roots of polynomials, Power series, Radius of convergence	3	K3	Interactive examples	Solving previous year NET/SET questions
	4.	Problems on Exponential, trigonometric, and hyperbolic functions in complex plane	2	K3 & K4	Lecture with illustration	Quizzes
	5.	Problems on Analytic Functions, Cauchy-Riemann equations	3	K3	Problem-solving	Assignments
IV	**Problems in contour integral**					
	1.	Problems in contour integral	2	K3	Problem solving	Group discussion
	2.	Cauchy theorem Cauchy's integral formula	3	K3	Lecture with illustration	Quiz using Kahoot
	3.	Liouville's theorem	2	K4	Lecture with illustration	Class test
	4.	Maximum modulus principle Schwarz lemma	3	K4	Problem solving	Brainstorming
	5.	open mapping Theorem	2	K4	Lecture with illustration	Group discussion
V	**Problem in Taylors Series, Laurents Series, calculus of residues, Conformal mappings, Mobius transformations**					
	1.	Problems in Taylors Series, Laurents Series	4	K2&K3	Interactive PPT	Presentation
	2.	Problems in calculus of residues	4	K3&K4	Group Discussion	Solving previous year NET/SET questions
	3.	Problems in Conformal mappings, Mobius transformations	4	K2&K3	Problem-solving	Assignments

Course Focussing on **Skill Development**

Activities (Em/ En/SD): Seminar, Quizzes, Group Discussions

Assignment: Solving problems in previous year NET/SET questions

Seminar Topic: Analytic Functions, Calculus of residues

Sample questions

Part A:

1.Say true or false: In any metric space every convergent sequence is a Cauchy sequence.

2.A metric space is said to be totally bounded if _____
a) Every Cauchy sequence converges.
b) For every ϵ>0, the space can be covered by finitely many ϵ -balls.
c) It is compact.
d) It contains no infinite subset.

3. If z=3+4i, then $|z|^2$ is _____
a) 7
b) 25
c) 10
d) 5

4.What does Liouville's Theorem state about bounded entire functions?

5. The radius of convergence for the Taylor series of ln(1+z) at z=0 is _____
a) 1
b) ∞

c) Valid for |z|<1
d) Not valid at z=1

Part B:

1. Let $\{x_n\}$ be a sequence in R defined by $x_{n+1}=\frac{x_n}{2}$. If $x1$=2, then discuss about the convergence of the sequence.

2. Check whether the following sets are connected in R under the standard metric?
a) [0,1]∪[2,3]
b) (0,1)
c) [0,1)

3.Test the convergence of the series $\sum_{n=0}^{\infty}\frac{z^n}{n!}$.

4.Using Schwarz's Lemma, show that a holomorphic self-map of the unit disk that fixes the origin has modulus less than or equal to 1.

5. For which type of singularity does the Taylor series converge?

Part - C

1.Check whether each of the following metric space is complete and bounded?
a) R under d(x,y)=|x−y|
b) Q under d(x,y)=|x−y|
c) [0,1] under d(x,y)=|x−y|
d) C under d(x,y)=|x−y|

2. Let $X=\{(x,y)\in R^2 : x^2+y^2\leq 1\}$ with the Euclidean metric. Check the validity of each of the following statements

a) X is connected.
b) X is compact.
c) X is not totally bounded.
d) X is complete.

3. Check the validity of each statement:

The Cauchy-Riemann equations guarantee:
a) Differentiability in the complex sense.
b) Analyticity of a function.
c) Continuity of u(x,y) and v(x,y)

d) Laplace's equation is satisfied.

4.Prove Liouville's Theorem and deduce that every bounded analytic function on the entire complex plane is constant.

5.Check the validity of each of the following statements:

For $f(z) = e^z + \sin(z)$, the Taylor expansion:
a) Contains both odd and even powers of z.
b) Converges for all z in ℂ.
c) Includes coefficients involving 1/n!.
d) Has no radius of convergence restriction.

Head of the Department: **Course Instructors**:

Dr. J.Anne Mary Leema Dr. J.Anne Mary Leema Dr.C.Jenila, Dr.J.Nesa Golden Flower