Teaching Plan PG (23-24)

PG-FIRST YEAR – SEMESTER – I

CORE – I: ALGEBRAIC STRUCTURES

Department :Mathematics

Class : I M.Sc
Title of the Course :ALGEBRAIC STRUCTURES
Semester : I
Course Code :MP231CC1

CourseCode	L	T	P	S	Credits	Inst. Hours	Marks		
							CIA	External	Total
MP231CC1	5	2	-	-	5	7	25	75	100

Learning Objectives

1. To understand the simple concepts of the theory of equations
2. To find the roots of the equations by using techniques in various methods.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO-1	Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups.	PSO - 1	K1
CO-2	Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules	PSO – 2	K2
CO-3	Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotenttransformation relating nilpotence with invariants.	PSO - 2	K3
CO-4	Define Jordan, canonical form, Jordan blocks, define rational canonical form, definecompanion matrix of polynomial, find the elementary devices of transformation, apply theconcepts to find	PSO - 3	K4

	characteristic polynomial of linear transformation.		
CO-5	Define trace, define transpose of a matrix, explain the properties of trace andtranspose, to find trace, to find transpose of matrix, to prove Jacobson lemma using thetriangular form, define symmetric matrix, skew symmetric matrix, adjoint, to defineHermitian, unitary, normal transformations and to verify whether the transformation inHermitian, unitary and normal	PSO - 3	K5

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Unit-I**					
	1.	Counting Principle	3	K1 &K2	Brainstorming	MCQ
	2.	Class equation for finite groups	3	K2	Lecture with illustrations	Slip Test
	3.	Class equation for finite groups andts applications	3	K3	Problem Solving	Questioning
	4.	Sylow’s theorems	6	K4	Lecture Discussion	Questioning
II	**Unit-II**					
	1.	Solvable groups	4	K1 &K2	Brainstorming	True/False
	2.	Direct products	4	K2	Flipped Classroom	Short summary
	3.	Finite abeliangroups	4	K2&K4	Lecture Discussion	Concept definitions
	4.	Modules	3	K3	Problem Solving	Quiz
III	**Unit-III**					
	1.	Linear Transformations:	3	K1 &K2	Brainstorming	Quiz
	2.	Canonical form	4	K2	Lecture with illustration	Explain
	3.	Triangularform	4	K2	Lecture Discussion	Slip Test

	4.	Nilpotent transformations	4	K3	Problem Solving	Open book Test
IV	**Unit-IV**					
	1.	Jordan form	3	K1 &K2	Brainstorming	Simple Questions
	2.	Differential equation of first order but of higher degree	4	K2	Blended Learning	Quiz
	3.	Equationssolvableforp,x,y	4	K3	Integrative method	Explain the concept
	4.	rational canonical form	4	K1 &K2	Collaborative learning	Slip Test
V	**Unit -V**					
	1.	Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.	4	K1 &K2	Flipped Classroom	MCQ
	2.	Hermitian transformation	4	K2	Lecture with illustration	Concept explanations
	3.	unitary, normal transformations	4	K2 &K3	Problem Solving	Questioning
	4.	real quadratic form.	3	K2	Group Discussion	Recall steps

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

Activities (Em/ En/SD):**Poster Presentation, Group Discussion**

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

Activities related to Cross Cutting Issues: -

Assignment: **Unsolved Problems (From Reference books)**

Part A

1. Sylow p-subgroup of a group *G*is--------------
2. Define Internal Direct Product

3. If V is finitedimensional over F then therank of T isthedimensionof --------------------

i. V b)T c)VT d)VT^{-1}

4.Thematrix A is saidto beaskew-symmetricmatrixif -----------------------

a) $A'=A$ b)$'=-A$ c)$A'=0$ d)$A'=1$

5.Theonlyirreducible,nonconstant,polynomialsoverthefieldofrealnumbersareeitherof

degree --.

a)1 or2 b)0 or2 c)0 or 1 d)1 or 3

Part B

1.Let G be a finite group. Prove that $C_a = o(G)/o(N(a))$.

2. Define double coset of 2 sub groups A and B in a group G and prove that

$$O(AxB) = \frac{O(A)O(B)}{O(A \cap xBx^{-1})}$$.

3.If V is finite dimensionalover F then showthat $T \in A(V)$ isinvertibleiffthe constant

termoftheminimal polynomial for T is not0.

4.Stateandprovethe Jacobson lemma

5.Prove thatdet$A$=det(A').

Part C

1.Provethat $I(G) \cong G/Z$,where $I(G)$ is the group of inner automorphisms of G and Z isthe centre of G .

2. State and prove Sylow's theorem.

3. If A is an algebra, with unit element over F, then prove that A is isomorphic to a

subalgebraof(V)forsomevectorspace$V$over$F$.

4.ProvethattheelementsSandTin$A_F(V)$aresimilarin$A_F(V)$ifandonlyiftheyhavethe

same elementarydivisors.

5.Prove that the Hermitian linear transformation T is non negative iff its characteristic rootsare nonnegative.

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Head of the Department **Course Instructor**

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

Teaching Plan

Department : **Mathematics**

Class : **I M.Sc. Mathematics**

Title of the Course :**Core II : Real Analysis I**

Semester : **I**

Course Code :**MP231CC2**

Course Code	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Total Hours**	**Marks**		
							CIA	**External**	**Total**
MP231CC2	**5**	**2**	**-**	**4**	**7**	**105**	**25**	**75**	**100**

Learning Objectives

1. To work comfortably with functions of bounded variation, Riemann- Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence.
2. To relate its interplay between various limiting operations.

Course outcomes

CO	**Upon completion of this course, the students will be able to:**	**PSO addressed**	**Cognitive level**
CO - 1	Analyze and evaluate functions of bounded variation and rectifiable Curves.	PSO - 1	K4, K5
CO - 2	Describe the concept of Riemann-Stieltjes integrals and its properties.	PSO - 2	K1, K2
CO - 3	Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.	PSO - 2	K3
CO - 4	Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.	PSO - 4	K3, K5
CO - 5	Formulate the concept and properties of inner products, norms and measurable functions.	PSO - 2	K2, K3

Total contact hours: 105 (Including instruction hours, assignments and tests)

Unit	**Module**	**Topic**	**Teaching**	**Cognitive**	**Pedagogy**	**Assessment/**

			Hours	level		Evaluation
I	**Functions of Bounded Variation, Infinite Series**					
	5.	Definition of monotonic function connected and disconnected functions compact sets and examples	2	K1, K2	Recall the basic definitions	Questioning
	6.	Properties of monotonic functions, Functions of bounded variation, Definition - Partition, Bounded variation, Examples of continuous functions that are not of bounded variation, Illustration on boundedness of f' is not necessary for f to be of bounded variation	4	K4, K5	Lecture with illustration	Summarize the concepts
	7.	Total variation – Definition, Behaviour of functions of bounded variation, Example illustrating reciprocal of functions of total variation need not be of total variation, Additive property of total variation	3	K2, K5	Illustrative Method	Questioning
	8.	Total variation on [a,x] as a function of the right end point x, Functions of bounded variation expressed as the difference of increasing functions – Characterisation of functions of bounded variation, Continuous functions of bounded variation	4	K2, K5	Lecture	Question and answer
	9.	Absolute and Conditional convergence, Definition – Absolutely convergent series, Example illustrating convergence does not imply absolute convergence, Dirichlet’s test and Abel’s	3	K2, K4	Illustrative method and Discussion	Slip test

		test				
	10.	Rearrangement of series, Riemann's theorem on conditional convergent series	3	K4	Lecture	Class test
II	**The Riemann - Stieltjes integral**					
	5.	The Riemann - Stieltjes integral – Introduction, Basics of calculus, Notation, Definition – refinement of partition, norm of a partition, The definition of The Riemann - Stieltjes integral, integrand, integrator, Riemann integral	3	K1	Brainstorming PPT	Questioning
	6.	Linear properties of Riemann - Stieltjes integral, Integration by parts, Connection between integrand and the integrator in a Riemann – Stieltjes integral	3	K2	Discussion and Lecture	Slip test
	7.	Change of variable in a Riemann – Stieltjes integral, Reduction to a Riemann integral, Step functions as integrators, Example showing that the existence of integral can also be affected by a change	4	K2	Flipped Classroom	Q & A
	8.	Reduction of a Riemann – Stieltjes integral to a finite sum, Definition – Step function, Euler's Summation formula, Monotonically increasing integrators, upper and lower integrals, Definition – upper and lower Stieltjes sums of f with respect to α for the partition P, Theorem illustrating for increasing α, refinement of partition	4	K2	Lecture	Quiz method

		increases the lower sums and decreases the upper sums				
	9.	Definition – Upper and lower Stieltjes integral, upper and lower Riemann sums, Examples, Additive and linearity properties of upper and lower integrals, Riemann's condition, Comparison theorems	4	K2	Illustration method	MCQ
III	**The Riemann - Stieltjes integral**					
	5.	Integrators of bounded variation, Sufficient conditions for existence of Riemann – Stieltjes integrals	3	K2	Lecture	Short test
	6.	Necessary conditions for existence of Riemann – Stieltjes integrals, Theorem illustrating common discontinuities from the right or from the left, Mean - value theorems for Riemann – Stieltjes integrals – first mean – value theorem, second mean – value theorem, the integral as a function of the interval and its properties	4	K3, K4	Lecture	Problem-solving
	7.	Second fundamental theorem of fundamental calculus, Change of variable in a Riemann integral, Second Mean – Value theorem for Riemann integrals	4	K3, K4	Lecture	Short test
	8.	Riemann – Stieltjes integrals depending on a parameter, Differentiation under the integral sign	3	K3, K5	Lecture	Questioning
	9.	Interchanging the order of integration, Lebesgue's	4	K4	Intertactive	Slip Test

		criterion for existence of Riemann integrals, Definition – measure zero, examples, Definition – oscillation of f at x, oscillation of f on T, Lebesgue's criterion for Riemann integrability			method	
IV	**Infinite Series and Infinite Products, Power Series**					
	5.	Double sequences, Definition – Double sequence, convergence of double sequence, Example, Definition – Uniform convergence, Double series, Double series and its convergence, Rearrangement theorem for double series, Definition – Rearrangement of double sequence	3	K1 & K2	Brainstorming	Quiz
	6.	A sufficient condition for equality of iterated series, Multiplication of series, Definition – Product of two series, conditionally convergent series, Cauchy product, Merten's Theorem, Dirichlet product	5	K3	Lecture	True/False
	7.	Cesaro Summability, Infinite products, Definition – infinite products, Cauchy condition for products	4	K2	Lecture	Concept Explanation
	8.	Power series, Definition – Power series, Multiplication of power series, Definition – Taylor's series	3	K3, K4	Lecture with chalk and talk	Slip Test
	9.	Abel's limit theorem, Tauber's theorem	3	K2, K4	Lecture Discussion	Q& A
V	**Sequences of Functions**					
	5.	Sequences of function – Pointwise convergence of	3	K2	Introductory	Explain

		sequence of function, Examples of sequences of real valued functions			Session	
	6.	Uniform convergence and continuity, Cauchy condition for uniform convergence	4	K2, K4	Lecture with illustration	Concept explanations
	7.	Uniform convergence of infinite series of functions, Riemann – Stieltjes integration, non-uniform convergence and term-by-term integration	2	K3, K4	Seminar Presentation	Questioning
	8.	Uniform convergence and differentiation, Sufficient condition for uniform convergence of a series, Mean convergence	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: **Uniform convergence, Absolute and Conditional convergence, Dirichlet's test and Abel's test, Riemann's theorem on conditional convergent series, Sequences of Functions, Uniform convergence.**

Sample questions

Part A

1. Rectifiable arcs have ________ arc length

(a) infinite (b) finite (c) countably finite (d) countably infinite

2. If $a < b$, we define $\int_a^b f d\alpha =$ _______ whenever $\int_a^b f d\alpha$ exists.

3. State the first mean value theorem for Riemann Stieltjes Integral.

4. State True or False: The two series $\sum_{n=0}^{\infty} z^n$ and $\sum_{n=1}^{\infty} z^n/n^2$ have the same radius of convergence.

5. Differentiate between pointwise convergence and uniform convergence.

Part B

1. Assume that f and g are each of bounded variation on $[a, b]$. Prove that so are their sum, difference and product. Also, prove $V_{f\pm g} \leq V_f + V_g$ and $V_{f*g} \leq AV_f + BV_g$ where $A = sup\{|g(x)| : x \in [a, b]\}$,$B = sup\{|f(x)| : x \in [a, b]\}$.

2. Assume that $\alpha \nearrow$ on $[a, b]$. Then prove that $\underline{I}(f, \alpha) \leq \bar{I}(f, \alpha)$.

3. Assume $f \in R(\alpha)$ and $g \in R(\alpha)$ on $[a, b]$, where $\alpha \nearrow$ on $[a, b]$. Define $F(x) = \int_a^x f(t)d\alpha\,(t)$ and $G(x) = \int_a^x f(t)d\alpha\,(t)$ if $x \in [a, b]$. Then prove that $f \in R(G)$ and $g \in R(F)$ on $[a, b]$ and we have $\int_a^b f(x)g(x)d\alpha\,(x) = \int_a^x f(x)dG\,(x) = \int_a^x g(x)dF\,(x)$.

4. Assume that the power series $\sum_{n=0}^{\infty} a_n(z - z_0)^n$ converges for each z in $B(z_0; r)$. Then prove that the function f defined by the equation $(z) = \sum_{n=0}^{\infty} a_n(z - z_0)^n$, if $z \in B(z_0; r)$, is continuous on $B(z_0; r)$.

5. Let $\{f_n\}$ be a sequence of functions defined on a set S. There exists a function f such that $f_n \to f$ uniformly on S if, and only if, the Cauchy condition is satisfied: For every $\epsilon > 0$ there exists an N such that $m > N$ and $n > N$ implies $|f_m(x) - f_n(x)| < \varepsilon$, for every x in S.

Part C

1. State and prove the additive property of total variation.

2. State and prove the formula for integration by parts.

3. State and prove the second fundamental theorem of integral calculus.

4. State and prove Abel's limit theorem.

5. State and prove Weierstrass M-test.

Head of the Department **Course Instructor**

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

Teaching Plan

Department : Mathematics

Class : I M.Sc

Title of the Course : Core Course III: Ordinary Differential Equations

Semester : I

Course Code : MP231CC3

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP231CC3	5	1	-	4	6	90	25	75	100

Learning Objectives

1. To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points.
2. To study existence and uniqueness of the solutions of first order differential equations

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	Establish the qualitative behavior of solutions of systems of differential equations.	PSO-5	**K5**
CO - 2	Recognize the physical phenomena modeled by differential equations and dynamical systems.	PSO-1	**K1**
CO - 3	Analyze solutions using appropriate methods and give examples.	PSO-4	**K4**
CO - 4	Formulate Green's function for boundary value problems.	PSO- 2	**K6**
CO - 5	Understand and use the various theoretical ideas and results that underlie the mathematics in course.	PSO-2	**K2 & K3**

Total contact hours: 75 (Including instruction hours, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	Linear equations with constant coefficients					
	11.	Second order homogeneous equations	3	K1 & K2	Brainstorming	MCQ
	12.	Initial value problems	3	K2	Lecture	Slip Test
	13.	Linear dependence and independence	3	K3	Lecture Discussion	Questioning
	14.	Wronskian and a formula	3	K1 & K3	Lecture	Questioning

		for Wronskian				
	15.	Non-homogeneous equation of order two.	3	K4	Problem Solving	Class test
II	Linear equations with constant coefficients					
	10.	Homogeneous equation of order n	3	K1	Lecture with Illustration	Questioning
	11.	Non-homogeneous equation of order n	3	K2	Problem solving	Short summary
	12.	Initial value problems-	3	K3	Brain storming	Concept definitions
	13.	Annihilator method to solve non-homogeneous equation	3	K5	Lecture with Problem solving	Recall steps
	14.	Algebra of constant coefficient operators.	3	K1	Problem solving	MCQ
III	Linear equation with variable coefficients					
	10.	Initial value problems	2	K1 & K2	Brainstorming	Quiz
	11.	Existence and uniqueness theorems	1	K3	Lecture	Explain
	12.	Solutions to solve a non-homogeneous equation	3	K6	Lecture Discussion	Slip Test
	13.	Wronskian and linear dependence	2	K4	Lecture	Questioning
	14.	Reduction of the order of a homogeneous equation	2	K3	Problem solving	Questioning
	15.	Homogeneous equation with analytic coefficients	3	K5	Problem Solving	Concept explanations
	16.	The Legendre equation.	2	K4	Lecture	MCQ
IV	Linear equation with regular singular points					
	10.	Euler equation	3	K1 & K2	Brainstorming	Quiz
	11.	Second order equations with regular singular points	5	K6	Lecture Discussion	Differentiate between various ideas
	12.	Exceptional cases	4	K3	Lecture	Explanations

					method	
	13.	Bessel Function.	3	K1 & K2	Problem solving	Slip Test
V	Existence and uniqueness of solutions to first order equations					
	9.	Equation with variable separated.	3	K1 & K2	Brainstorming	MCQ
	10.	Exact equation	3	K4	Lecture	Concept explanations
	11.	Method of successive approximations	3	K1 & K2	Problem solving	Questioning
	12.	The Lipschitz condition	2	K4	Lecture	Recall steps
	13.	Convergence of the successive approximations and the existence theorem.	4	K1 & K2	Lecture	True/False

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): -

Activities related to Cross Cutting Issues: -

Assignment: Exercise Problems inthe Method of successive approximations

Sample questions (minimum one question from each unit)

Part A

1. The solution of $y'' - 4y = 0$ is _____________.

2. Choose the correct answer

a) $2|b||c| \leq |b|^2 + |c|^2$

b) $2|b||c| \geq |b|^2 + |c|^2$

c) $2|b||c| = |b|^2 + |c|^2$

d) None

3. The roots of the characteristic polynomial $r^3 - 3r + 2 = 0$ are _____, _____, _____.

4. State True or False

If φ is a solution of $L(y) = 0$ which is such that $\varphi(x_0) = \alpha_1, \varphi'(x_0) = \alpha_2 \ldots \varphi^{(n-1)}(x_0) = \alpha_n$ where $\alpha_1, \alpha_2, \ldots, \alpha_n$ are real constants, then φ is real valued

5. A linear differential equation of order n with variable coefficients is of the form is _______.

6. State True or False: The Legendre equation is

$L(y) = (1 - x^2)y'' - 2xy' + \alpha(\alpha + 1)y = 0.$

7. The indicial polynomial for $x^2y'' + a(x)xy' + b(x)y = 0$ is

a) $r^2 + a(x)r + b(x) = 0$

b) $r^2 + a(x)xr + b(x) = 0$

c) $r(r - 1) + r\alpha_0 + \beta_0 = 0$

d)) $r(r - 1) - r\alpha_0 - \beta_0 = 0$

8. State True or False

If α is a constant. $Re\ \alpha \geq 0$. The Bessel equation of order α is of the form

$L(y) = x^2y'' + xy' + (x^2 - \alpha^2)y = 0.$

9. The equation $M(x, y) + N(x, y)y' = 0$ is said to be exact in R if there exists a function

F having continuous first partial derivatives there such that ___________in R.

a) $\frac{\partial F}{\partial x} = M \quad \frac{\partial F}{\partial y} = N$

b) $\frac{\partial F}{\partial x} = N \quad \frac{\partial F}{\partial y} = M$

c) $\frac{\partial F}{\partial x} = \frac{\partial F}{\partial y} = M$

d) None

10. What is the value of M and N in $y' = \frac{3x^2 - 2xy}{x^2 - 2y}$?

PART-B

11.a) Find the solutions of $y'' - 2y' - 3y = 0, y(0) = 0, y'(0) = 1.$

(OR)

b) If φ_1, φ_2 are two solutions of L(y)=0 on an interval I containing x_0 then prove that $W(\varphi_1, \varphi_2)(x) = e^{-a_1(x-x_0)}\ W(\varphi_1, \varphi_2)(x_0)$

12. a) Solve $y^{(4)} + y = 0.$

(OR)

b) The functions $\varphi_1(x) = 1,\ \varphi_2(x) = x,\ \ \varphi_3(x) = x^3$ are defined on $-\infty < x < \infty$. Prove that they are linearly independent.

13a) Find all the solutions of the equation $y'' - \frac{2}{x^2}y = x$, $(0 < x < \infty)$.

(OR)

b) Find two linearly independent power series solutions of $y'' - xy' + y = 0$.

14a) Find the solution of $x^2y'' + \frac{3}{2}xy' + xy = 0$

(OR)

b) Show that $x^{\frac{1}{2}}J_{\frac{1}{2}}(x) = \frac{\sqrt{2}}{\Gamma(\frac{1}{2})}\ sinx$

15. a) Solve $y' = y^2$ with initial condition $\varphi(1) = -1$.

(OR)

b) Solve $y' = \frac{x+y}{x-y}$

PART- C

16.a) Solve $y'' - y' - 2y = e^{-x}$

(OR)

b) Let φ be any solution of $L(y) = y'' + a_1y' + a_2y = 0$ on an interval I containing a point x_0. Then prove that for all x in I, $\| \varphi(x_0) \|\ e^{-k|x-x_0|} \leq \| \varphi(x) \| \leq \| \varphi(x_0) \|\ e^{k|x-x_0|}$.

17a) Solve $y''' + y'' + y' + y = 1$ which satisfies $\psi(0) = 0, \psi'(0) = 1, \psi''(0) = 0$.

(OR)

b) Find the solution of the non-homogeneous equation of order n.

18a) Two solutions of $x^3y''' - 3xy' + 3y = 0\ (x > 0)$ are $\varphi_1(x) = x,\ \ \varphi_2(x) = x^3$. Find the third independent solution.

(OR)

b) Show that $\int_{-1}^{1} P_n^2(x)dx = \frac{2}{2n+1}$

19a.) $xy'' + (1 - x)y' + \alpha y = 0$ where α is a constant is called a Laguerre equation

(i) Show that this equation has a regular point at x=0

(ii) Compute the indicial polynomial and its roots

(iii) Find a solution φ of the form $\varphi(x) = x^r \sum_{k=0}^{\infty} C_k x^k$

(OR)

b) Obtain two linearly independent solutions of $x^2y'' + 3xy' + (1 + x)y = 0$ which are valid near x=0

(OR)

20a.) State and prove the existence theorem for successive approximation

b.) Compute the first four approximation $\varphi_{0},\ \varphi_{1},\ \varphi_{2},\ \varphi_{3},$ of $y' = x^2 + y^2$

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Dr.K. Jeya Daisy**

Teaching Plan

Department : Mathematics

Class : I M.Sc

Title of the Course :Elective I: a) NUMBER THEORY & CRYPTOGRAPHY

Semester : I

Course Code : MP231EC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP231EC1	4	1	-	4	5	75	25	75	100

Learning Objectives:

1. To gain deep knowledge about Number theory.
2. To know the concepts of Cryptography.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	Understand quadratic and power series forms and Jacobi symbol.	**K1 & K2**

2	Apply binary quadratic forms for the decomposition of a number into sum of sequences.	**K3**
3	Determine solutions using Arithmetic Functions.	**K3**
4	Calculate the possible partitions of a given number and draw Ferrer's graph.	**K4**
5	Identify the public key using Cryptography.	**K5 & K6**

Total contact hours: 75 (Including instruction hours, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I		**Divisibility and Congruences**				
	1.	Divisibility, definition, and Theorems based on divisibility - Division Algorithm, Euclidean algorithm	3	K1	Brainstorming	MCQ
	2.	Congruences definition, and Theorems based on congruences – Fermat's Theorem - Euler's theorem - Wilson's Theorem	3	K2	Lecture	Slip Test
	3.	Chinese Remainder Theorem	3	K3	Lecture Discussion	Explanations
	4.	Primitive roots	3	K1 & K3	Lecture	Questioning
	5.	Power residues	3	K4	Problem Solving	Class test

II	**Quadratic Reciprocity and Quadratic Forms**					
	1.	Quadratic Residues, definition, Legendre symbol definition and Theorem based on Legendre symbol	3	K1	Lecture with Illustration	Questioning
	2.	Lemma of Gauss, Theorem based on Legendre symbol	3	K2	Problem solving	Evaluation through test
	3.	Quadratic reciprocity law, Theorem based on Quadratic reciprocity.	3	K3	Brain storming	Concept definitions
	4.	The Jacobi symbol definition and examples, Theorems based on Jacobi symbol	3	K5	Lecture with Illustration	Recall steps
	5.	Theorem based on Jacobi symbol and Legendre symbol	3	K1	Lecture with Illustration	MCQ
III	**Some Functions of Number Theory**					
	1.	Definition and examples based on Arithmetic functions, Multiplicative function	4	K1 & K2	Brainstorming	Quiz
	2.	Theorems on arithmetic and multiplicative function.	4	K3	Lecture	Concept explanations
	3.	Definition and theorem of Mobius function, The Mobius Inversion Formula	4	K6	Lecture Discussion	Slip Test
	4.	Theorem on Mobius function and Multiplicative function	3	K4	Lecture	MCQ

IV	**Some Diophantine equations**					
	1.	Definition and examples of Diophantine Equations, theorem on finding solutions of Diophantine Equations	3	K1 & K2	Brainstorming	Quiz
	2.	Solving problems on Diophantine equation.	4	K4	Problem solving	Recall steps
	3.	Definition and examples of Pythagorean triangle, Lemma on perfect square	4	K3	Lecture method	Explanations
	4.	Assorted Examples	4	K2	Problem solving	Slip Test
V	**Public Key Cryptography**					
	1.	Definition and examples of Cryptography, the concepts of Public Key Cryptography with examples	3	K1 & K2	Brainstorming	MCQ
	2.	The idea of classical vesus public key, Authentication, Hash functions, key exchange and probabilistic Encryption.	3	K4	Lecture	Concept explanations
	3.	RSA Cryptosystem with examples, Discrete log cryptosystem with examples, The Diffie – Hellman key exchange system and assumption with examples.	3	K1 & K2	Problem solving	Questioning
	4.	The Massy- Omura cryptosystem for message transmission, the ElGamal cryptosystem, the Digital Signature Standard, Algorithm for finding discrete log in finite fields with example and index calculus algorithm for discrete logs	2	K4	Lecture	Explanations

	5.	Basic facts of Elliptic curves, Elliptic curves over the reals, complexes and rationals, Points of finite order with examples.	2	K1 & K2	Lecture	True/False
	6.	Analog of the Diffie-Helman key exchange, Analog of Massey -Omura, Analog of ElGamal, reducing a global modulo p with examples.	2	K3	Lecture with illustration	Assignment

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

Activities (Em/ En/SD): **Group Discussion**

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

Activities related to Cross Cutting Issues: -

1. **Case Study on RSA Encryption - A Number Theoretic Approach to Cryptography**
2. **Writing reflective essays on the ethical dilemmas and human values associated with using cryptographic methods for various purposes.**

Assignment: **Seminar, Open Book Test**

Sample questions (minimum one question from each unit)

PART A

1. If (a,m) = (b,m) = 1, then (a,bm) = 1 **(Say True or False)** (R)
2. Evaluate the value of $\left(\frac{3}{61}\right)$.(E)
3. If (m,n) = 1, then d(mn)= ----------- (An)
4. The equation $x^2+y^2= -1$ has ---------no solution in integers (R)

   a) solution in integers b) no solution in integers

   c) two solutions in integers d) none of the above
5. Choose an algorithm that can be used to sign a message. (Ap)

   a) Public key algorithm b) Private key algorithm

   c) Public & Private key algorithm d) None of the mentioned

PART B

6. State and prove the Division Algorithm.

7. Prove that if p is an odd prime, then $\left(\frac{a}{p}\right) \equiv a^{(p-1)/2} (\bmod\ p)$. (E)

8. For every positive integer n, $\sum_{din} \Phi(d) = n$ (E)

9. Find all integers x and y such that 147x + 258y = 369(Ap)

10. Describe the analog of Massey-Omura. (U)

PART C

11. State and prove the Chinese Remainder Theorem. (U)

12. If p is an odd prime and (a,2p) = 1, then prove that $\left(\frac{a}{p}\right) = (-1)^t$ where t $=\sum_{j=1}^{\frac{(p-1)}{2}} \left[\frac{ja}{p}\right]$.

Also $\left(\frac{2}{p}\right) = (-1)^{\frac{(p^2-1)}{8}}$. (E)

13.State and prove Mobius inversion formula. (R)

14. Find all the solutions of 999x – 49y = 5000 (Ap)

15. Find the type of $y^2 = x^3 - x$ over F_{71}. (R)

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Dr.T.Sheeba Helen**

Teaching Plan

Department : Mathematics
Class : I M.Sc Mathematics
Title of the Course : Elective I: Discrete Mathematics
Semester : I
Course Code : MP231EC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP231EC1	9	6	-	3	5	75	25	75	100

Objectives

1. To learn the concepts of Permutations, Combinations, Boolean Algebra and Lattices
2. To motivate the students to solve practical problems using Discrete mathematics

Course outcomes

On the successful completion of the course, student will be able to:

CO1	remember and interpret the basic concepts in permutations and combinations and distinguish between distribution of distinct and non-distinct objects	**K1,K2, K4**
CO2	Interpret the recurrence relation and generating functions and evaluate by using the technique of generating functions	**K2, K3**
CO3	Solve the problems by the principle of inclusion and exclusion	**K3**
CO4	To prove the basic theorems in Boolean Algebra and to develop the truth table for a Boolean expression	**K2**
CO5	Differentiate between variety of lattices and their properties	**K4**

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	Permutations and combinations, The rules of sum and product	3	K1(R)	Lecture using Chalk and talk,Introductory session, Group Discussion, Lecture using videos, Problem solving, PPT	Simple definitions, MCQ, Recall formulae
	2.	Permutations, Combinations	4	K2(U)	Lecture using videos, Peer tutoring, Problem solving, Demonstration, PPT, Review	Quiz, MCQ, Recall formulae
	3.	Distribution of distinct objects	4	K4(An)	Lecture using Chalk and talk, Lecture using videos, Problem solving, PPT	Suggest formulae, Solve problems, Home work
	4.	Distribution of non-distinct objects	4	K4(An)	Lecture using Chalk and talk, Lecture using videos, Problem solving, PPT	Class test, Problem solving questions, Home work
II						
	1.	Generating functions	3	K1(R), K2(U)	Lecture using Chalk and talk, Problem solving	Simple definitions, MCQ, Recall formulae
	2.	Generating functions for combinations	3	K3(Ap), K2(U)	Lecture using Chalk and talk, Problem solving	Problem solving, Home work
	3.	Recurrence relations	3	K2(U)	Lecture using	Home work

					Chalk and talk, Problem solving	
	4.	Linear recurrence relations with constant coefficients	3	K3(Ap)	Lecture using Chalk and talk, Group Discussion, Problem solving, PPT	Slip test, Assignments
	5.	Solution by the technique of generating functions	3	K3(Ap)	Lecture using Chalk and talk, Problem solving	Class Test, Problem solving
III						
		The principle of inclusion and exclusion	5	K3(Ap), K2(U)	Lecture using Chalk and talk, Group Discussion, Problem solving, PPT	Slip test, Problem solving, Explain
		The general formula	5		Lecture using Chalk and talk, Problem solving	Brain Storming, Problem solving
		Derangements	5	K3(Ap)	Lecture using Chalk and talk, Problem solving	Home work
IV						
		Boolean Algebra: Introduction	3	K2(U)		Brain Storming
		Basic Theorems on Boolean Algebra	3	K2(U)	Lecture using Chalk and talk, Problem solving, Peer tutoring	Brain Storming, Problem solving
		Duality Principle	3	K2(U)	Lecture using Chalk and talk, Problem	Slip test, Assignments

					solving, Peer tutoring	
		Boolean Functions	3	K2(U)	Lecture using Chalk and talk, Peer tutoring	Oral test
		Applications of Boolean algebra	3	K3(Ap), K4(An)	Lecture using Chalk and talk, Problem solving, Peer tutoring	Brain Storming, Problem solving
V						
		Posets and Lattices: Introduction	2	K2(U)	Lecture using Chalk and talk, Peer tutoring	Class test
		Totally Ordered Set or Chain	3	K2(U)	Lecture using Chalk and talk, Peer tutoring	Problem solving, Home work
		Product Set and Partial Order Relation	3	K3(Ap)	Lecture using Chalk and talk, Peer tutoring	Slip test, Assignments
		Hasse Diagrams of Partially Ordered Sets	3	K2(U)	Graphical representation, Demonstration	Suggest formulae, Solve problems, Home work
		Lattice- Duality	2	K4(An)	Lecture using Chalk and talk, Problem solving, Peer tutoring	Slip test, Assignments
		Types of Lattices	2	K4(An)	Lecture using Chalk and talk, Problem solving, Peer tutoring	Simple definitions, MCQ, Recall formulae

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

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

Assignment : The Tower of Hanoi Problem, Applications of Boolean algebra

Seminar Topic: Basic Theorems of Boolean Algebra and Lattices

Sample questions:

Part-A

1. Out of a large number of pennies, nickels, dimes and quarters, in how many ways can six coins be selected?

   a) 6 b) 84 c) 60 d) 3

2. What is the coefficient of the term x^{23}in $(1 + x^5 + x^9)^{100}$?

   a) 485500 b) 485000 c) 485100 d)481000

3. Write the recurrence relation representing the series $1, 3, 3^2, 3^3, \ldots, 3^n$

4. Say True or False: Boolean algebra has no operation equivalent to subtraction and division.

5. Say True or False: A subset of poset may not have lower or upper bound.

Part – B

6. If no three diagonals of a convex decagon meet at the same point inside the decagon into how many line segments are the diagonals divided by their intersections.

7. Prove the identity $\binom{n}{0}^2 + \binom{n}{1}^2 + \binom{n}{2}^2 + \cdots \binom{n}{n}^2 = \binom{2n}{n}$

8. Solve the recurrence relation using generating function $a_n = a_{n-1} + 2(n-1)$with the boundary condition $a_1 = 2$.

9. State and Prove the DeMorgan's Law in Boolean Algebra

10. Prove that the digraph of a partial order has no cycle of length greater than one

Part – C

11. (i) Find the number of n-digit binary sequences that contain an even number of 0's.?(E)

    (ii) What is the number of n digit quaternary sequence that has even number of zero's?

12. (i) Find the number of ways in which 4 persons, each rolling a single die once, can have total score of 17?

    (ii) What is the ordinary enumerator for the selection of r objects out of n objects $(r \geq n)$,with unlimited repetitions, but with each object included in each selection.

13. State and prove the principle of inclusion and exclusion.

14. A committee of three experts for deciding the acceptance or rejection of photographs for exhibition is provided with buggers which members of the committee push to indicate acceptance. Design a circuit so that a bell will ring when there is a majority vote for acceptance.

15. A poset has at most one greatest element and one least element.

Head of the Department **Course Instructor**

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

Teaching Plan

Department : Mathematics

Class : II M.Sc

Title of the Course :Major Core IX: Field Theory and Lattices

Semester : III

Course Code :PM2031

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
PM2031	**6**	**-**	**-**	**5**	**6**	**90**	**40**	**60**	**100**

Learning Objectives

1. To learn in depth the concepts of Galois Theory, theory of modules and lattices
2. To pursue research in pure Mathematics

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	recall the definitions and basic concepts of field theory and lattice theory	PSO - 2	K1
CO - 2	express the fundamental concepts of field theory, Galois theory	PSO - 2	K2
CO - 3	demonstrate the use of Galois theory to construct Galois group over the rationals and modules	PSO - 3	K5
CO - 4	distinguish between field theory and Galois theory and write theorems	PSO - 3	K3
CO - 5	interpret distributivity and modularity and apply these concepts in Boolean Algebra	PSO - 4	K4

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Extension Fields**					
	6.	Definition -Extension field, dimension, Finite extension and subfield	2	K1 &K2	Brainstorming	MCQ
	7.	Theorems on finite extension	3	K3	Lecture	Slip Test
	8.	Theorems on algebraic over a field F	3	K3	Lecture Discussion	Questioning
	9.	Theorems on algebraic extension	3	K3	Lecture	Questioning
	10.	Interpretation of Extension fields such as finite extension, algebraic extension	3	K3	Collaborative learning	Concept explanations
	11.	algebraic number and transcendental number with illustrations	1	K1 &K2	Blended classroom	Evaluation through short test
II	Roots of Polynomials					
	6.	Definition- roots of polynomials, multiplicity of roots	1	K1	Brainstorming	True/False
	7.	Remainder theorem	1	K2	Flipped Classroom	Short summary
	8.	Theorems based on roots of polynomials	2	K3	Lecture Discussion	Concept definitions
	9.	Existence theorem of splitting fields	2	K3	Group Discussion	Recall steps
	10.	Theorems based on isomorphism of fields	2	K3	Lecture with Illustration	Questioning

	11.	Theorems based onsplitting field of polynomials	2	K3	Blended classroom	MCQ
	12.	Uniqueness theorem of splitting fields	2	K3	Peer Instruction	Slip Test
	13.	Definition- derivative of polynomials, Simple extension	1	K1 &K2	Flipped Classroom	Quiz
	14.	Theorems on simple extension	2	K3	Integrative method	Evaluation through short test
III	Galois Theory					
	5.	Definition -Fixed Field, Group of automorphism	1	K1 &K2	Brainstorming	Quiz
	6.	Theorems on Fixed Field	2	K3	Lecture	Explain
	7.	Theorems on Group of Automorphism	2	K3	Lecture Discussion	Slip Test
	8.	Theorems on Normal Extension	2	K3	Lecture	Questioning
	9.	Theorems on Galois Group	2	K3	Collaborative learning	Questioning
	10.	Construct theorems on Normal Extension and Galois Group	2	K5	Poster Presentation	Concept explanations
	11.	Theorems on Galois Group over the rationals	2	K5	Blended classroom	Overview
	12.	Problems based on Galois Group over the rationals	2	K3	Group Discussion	Solve problems
IV	Finite Fields					
	5.	Definition -Finite Fields, Characteristic of Fwith examples	1	K1 &K2	Brainstorming	Quiz
	6.	Theorems based on Finite Fields and Characteristic of F	5	K3	Flipped Classroom	Differentiate between various ideas
	7.	Wedderburn’s Theorem on finite division ring	3	K3	Integrative method	Explain

	8.	Definitions- Algebraic over a field	1	K1 &K2	Collaborative learning	Slip Test
	9.	Lemma based on algebraic over a field	1	K3	Lecture Discussion	Questioning
	10.	A Theorem of Frobenius	4	K3	Lecture Discussion	Concept explanations
V	Lattice Theory					
	7.	Definitions -Partially ordered set and examples	1	K1 &K2	Seminar Presentation	MCQ
	8.	Theorems based on Partially ordered set	4	K4	Seminar Presentation	Concept explanations
	9.	Definitions -Totally ordered set, Lattice, Complete Lattice	2	K1 &K2	Seminar Presentation	Questioning
	10.	Theorems based on Complete lattice, Distributive Lattice	4	K4	Seminar Presentation	Recall steps
	11.	Definitions -Modular Lattice, Boolean Algebra, Boolean Ring	1	K1 &K2	Seminar Presentation	True/False
	12.	Theorems based on Modular Lattice, Boolean Algebra, Boolean Ring	3	K4	Seminar Presentation	Evaluation through short test

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

Activities (Em/ En/SD):**Poster Presentation, 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:**Make an interactive PPT (Any topic from the syllabus)**

Seminar Topic: **Unit V- Lattices**

Sample questions (minimum one question from each unit)

Part A

4. Complete: [L:F] =-------------------

   a) [L:K]+ [K:F] b) [L:K]-[K:F] c) [L:K][K:F] d) [L:K]/[K:F]

5. 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
6. What is the Galois group of x^3 -3x -3 over Q?
7. Say True or False: $\Phi_3(x) = x^2 + x + 1$ is a cyclotomic polynomial
8. A ring is called Boolean if all of it's elements are ___________.
   a)invertible b)idempotent c)identity d)none

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. Let C be the field of complex numbers and suppose that the division ring D is algebraic over C. Then prove that D = C.
5. Show that any totally ordered set is a distributive Lattice.

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: The lattice of normal subgroups of a group is modular. The lattice of submodules of a module is modular

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Dr.S.Sujitha**

Teaching Plan

Department : Mathematics

Class : II M.Sc

Title of the Course : Major Core X: Topology

Semester : III

Course Code : PM2032

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

PM2031	**6**	**-**	**-**	**5**	**6**	**90**	**40**	**60**	**100**

Learning Objectives

1. To distinguish spaces by means of simple topological invariants.
2. To lay the foundation for higher studies in Geometry and Algebraic Topology

Course outcomes

CO	**Upon completion of this course, the students will be able to:**	**PSO addressed**	**Cognitive level**
CO - 1	understand the definitions of topological space, closed sets, limit points, continuity, connectedness, compactness, separation axioms and countability axioms.	PSO - 3	K2
CO - 2	construct a topology on a set so as to make it into a topological space	PSO - 4	K6
CO - 3	distinguish the various topologies such as product and box topologies and topological spaces such as normal and regular spaces.	PSO - 3	K2, K4
CO - 4	compare the concepts of components and path components, connectedness and local connectedness and countability axioms.	PSO - 2	K4, K5
CO - 5	apply the various theorems related to regular space, normal space, Hausdorff space, compact space to other branches of mathematics.	PSO - 1	K3
CO - 6	construct continuous functions, homeomorphisms and projection mappings.	PSO - 4	K6

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

Unit	**Module**	**Topic**	**Teaching Hours**	**Cognitive level**	**Pedagogy**	**Assessment/ Evaluation**
I	**Topological space and Continuous functions**					

	12.	Definition of topology, discrete and indiscrete topology, finite complement topology, Basis for a topology and examples, Comparison of standard and lower limit topologies	4	K2	Introductory Session with PPT	Questioning
	13.	Order topology: Definition & Examples, Product topology on XxY: Definition & Theorem	4	K3	Lecture	Concept explanations
	14.	The Subspace Topology: Definition & Examples, Theorems	3	K2, K6	Illustrative Method	Questioning
	15.	Closed sets: Definition & Examples, Theorems, Limit points: Definition Examples & Theorems , Hausdorff Spaces: Definition & Theorems	4	K1, K2	Seminar and Lecture	Recall simple definitions
	16.	Continuity of a function: Definition, Examples, Theorems, Homeomorphism: Definition & Examples, Rules for constructing continuous function, Pasting lemma & Examples, Maps into products	4	K1, K6	Illustrative method and Discussion	Recall basic definition and concepts
II	**The Product Topology, The Metric Topology & Connected Spaces**					
	15.	The Product Topology: Definitions,Comparison of box and product topologies, Theorems related to product topologies, Continuous functions and examples	3	K4	Brainstorming	Debating
	16.	The Metric Topology: Definitions and Examples, Theorems, Continuity of a function, The sequence lemma, Constructing continuous fuctions,	5	K2, K3	Discussion and Lecture	Slip test

		Uniform limit theorem, Examples and Theorems				
	17.	Connected Spaces: Definitions, Examples, Lemmas and Theorems, Connected Sub space of the real lines: Definitions and Examples, Theorems, Intermediate value theorem, connected space open and closed sets, lemma, examples, Theorems.	4	K1, K3	Seminar and Flipped Classroom	Concept definitions
	18.	Components and Local Connectedness: Definitions, Path components, Locally connected, Locally path connected: Definitions and Theorems	4	K3, K4	Lecture with PPT	Recall steps
	19.	The Product Topology: Definitions, Comparison of box and product topologies, Theorems related to product topologies, Continuous functions and examples	4	K3, K4	Illustration method with PPT	Differentiate between various ideas
III	**Compactness**					
	13.	Compact space: Definition, Examples, Lemma, Theorems and Image of a compact space, Product of finitely many compact spaces, Tube lemma, Finite intersection property: Definition & Theorem	4	K1 & K2	Seminar and flipped class room	MCQ
	14.	Compact Subspaces of the Real Line: Theorem, Characterize compact subspaces of R^n, Extreme value theorem, The Lebesgue number lemma, Uniform continuity theorem	4	K3& K4	Lecture	Explain
	15.	Limit Point Compactness: Definitions, Examples and	5	K1 &K3	Seminar and	Slip Test

		Theorems, Sequentially compact			Discussion	
	16.	Complete Metric Spaces: Definitions, Examples and Theorems, Isometric embedding	4	K3& K4	Lecture	Questioning
	17.	Compactness in Metric spaces: Totally bounded, Pointwise bounded, Equicontinuous, Definitions, Lemmas, Theorems	5	K3& K4	Collaborative learning	Slip Test
IV	**Compactness, Countability and Separation axioms**					
	11.	Local compactness: Definition & Examples, Theorems	3	K1 & K2	Brainstorming	Quiz
	12.	First Countability axiom, Second Countability axiom: Definitions, Theorems, Dense subset: Definitions & Theorem, Examples, Lindelof space : Definition, Examples	5	K3	Lecture	Differentiate between various ideas
	13.	The Separation Axioms: Regular space & Normal space: Definitions, Lemma, Relation between the separation axioms, Examples based on separation axioms, Theorem based on separation axioms and Metrizable space	4	K3	Integrative method	Concept Explanation
	14.	Normal Spaces: Theorems and Examples	3	K1 & K2	Collaborative learning	Slip Test
	15.	Urysohn lemma	1	K2	Lecture Discussion	Questioning
V	**UrysohnMetrizationTheorem, Tietze Extension Theorem,&TheTychonoff Theorem**					
	13.	Urysohnmetrization theorem, Imbedding theorem	3	K2	Seminar Presentation	Short test

	14.	Tietze extension theorem	4	K2	Seminar Presentation	Concept explanations
	15.	The Tychonoff Theorem	2	K1 & K2	Seminar Presentation	Questioning
	16.	The Stone-CechCompactification: Defintions,	4	K2	Seminar Presentation	Recall steps

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

Activities (Em/ En/SD):**Poster Presentation, 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:**Prove given results (Exercise problems in the text book)**

Seminar Topic: **Closed Sets, Limit Points, Continuity of a Functions, Connected Space and Dense Sets**

Sample questions

Part A

1. Which pair of topologies are not comparable?

(i) $\mathbb{R}_l$ and $\mathbb{R}$

(ii) $\mathbb{R}_k$ and $\mathbb{R}$

(iii) $\mathbb{R}_l$ and $\mathbb{R}_k$

(iv) None of the above

2. Let $f: A \rightarrow \prod_{\alpha \in J} X_\alpha$ be given by the equation $f(a) = (f_\alpha(a))_{\alpha \in J}$, where $f_\alpha: A \rightarrow X_\alpha$ for each α. If $\prod X_\alpha$ has the product topology, then f is continuous iff

(i) At least one f_α is continuous

(ii) At most one f_α is continuous

(iii) Each f_α is continuous

(iv) None of the above

3. Under which mapping the image of compact space is compact

(i) Bijective mapping

(ii) Injective mapping

(iii) Continuous mapping

(iv) Uniform continuous mapping

4. A space for which every open covering contains a countable subcovering is called a _________.

5. Say True or False: The Tietze extension theorem implies the Uryshon lemma.

Part B

6. Define order topology and give two examples for the same.
7. Let X be a metric space with metric d. Then prove that $\bar{d}: X \times X \rightarrow \mathbb{R}\ by\ \bar{d}(x, y) = \min\{d(x, y), 1\}$ is a metric that induces the same topology as d.
8. Show that compactness implies limit point compactness.
9. Prove that every metrizable space is normal.
10. If X is a completely regular space; Y_1 and Y_2 are two compactifications of X satisfying the extension property, then prove that Y_1 and Y_2 are equivalent.

Part C

6. Let X be an ordered set in the order topology and Y be a subset of X that is convex in X. Then show that the order topology on Y is the same as the topology Y inherits as a subspace of X.
7. Prove that the topologies on $\mathbb{R}^n$ induced by the Euclidean metric d and the square metric ρ are the same as the product topology on $\mathbb{R}^n$.
8. State and prove the Lebesgue number lemma.
9. Prove that a subspace of a Hausdorff space is Hausdorff and a product of Hausdorff spaces is Hausdorff.
10. State and prove Tychonoff theorem.

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Dr. M. K. Angel Jebitha**

Department : Mathematics
Class : II M.ScMathematics
Title of the Course : Major Core XI: Measure Theory and Integration
Semester : III
Course Code : PM2033

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 generalize the concept of integration using measures.

2. To develop the concept of analysis in abstract situations.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	define the concept of measures and Vitali covering and recallsome properties of convergence offunctions,	PSO - 1	K1(R)
CO - 2	cite examples of measurable sets , measurable functions,Riemann integrals, Lebesgue integrals.	PSO - 3	K2(U)
CO - 3	apply measures and Lebesgue integrals to various measurable sets and measurable functions	PSO - 2	K3(Ap)
CO - 4	apply outer measure, differentiation and integration tointervals , functions and sets.	PSO - 2	K3(Ap)
CO - 5	compare the different types of measures and Signed measures	PSO - 3	K4(An)

Teaching plan

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Lebesgue Measure**					
	1.	Lebesgue Measure - Introduction, outer measure	4	K2(U)	Lecture, Illustration	Evaluation through short test,MCQ, True/False, Short essays, Concept explanations
	2.	Measurable sets and Lebesgue measure	5	K1(R)	Lecture, Group discussion	Simple definitions, MCQ, Recall steps, Concept definitions
	3.	Measurable functions	4	K2(U)	Lecture, Discussion	Suggest idea/concept with examples, Suggest formulae, Solve problems
	4.	Littlewood's three principles (no proof for first two).	2	K4(An)	Lecture, Illustration	Evaluation through short test, Seminar
II	**The Lebesgue integral**					
	1.	The Lebesgue integral - the Riemann Integral	1	K1(R)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping, Peer tutoring, Lecture using videos, Problem solving, Demonstration, PPT, Review	Simple definitions, MCQ, Recall steps, Concept definitions Suggest idea/concept with examples, Suggest formulae, Solve problems Evaluation through short test, Seminar
	2.	The Lebesgue integral of a bounded function over a set of finite measure	5	K2(U)		
	3.	The integral of a non-negative function	5	K3(Ap)		
	4.	The general Lebesgue integral	4	K2(U)		
III	**Differentiation and integration**					
	1.	Differentiation and integration- differentiation of monotone functions	4	K1(R)	Lecture, Illustration	Evaluation through short test,MCQ, True/False, Short essays, Concept explanations
	2.	Functions of bounded variation	4	K3(Ap)	Lecture, Group discussion	Simple definitions, MCQ, Recall steps, Concept definitions

	3.	Differentiation of an integral	4	K3(Ap)	Lecture, Discussion	Suggest idea/concept with examples, Suggest formulae, Solve problems
	4.	Absolute continuity	3	K4(An)	Lecture, Illustration	Evaluation through short test, Seminar
IV	**Measure and integration**					
	1.	Measure and integration- Measure spaces	3	K2(U)	Lecture using Chalk and talk ,Introductory session, Group Discussion, Mind mapping,	Seminar on measure spaces, measurable functions and integration. Short test on general convergence theorems and signed measures
	2.	Measurable functions	3	K1(R)		
	3.	Integration	3	K3(Ap)		
	4.	General convergence theorems	3	K4(An)		
	5.	Signed measures	3	K2(U)		
V	**The L^P spaces and Measure and outer measure**					
	1.	The L^P spaces	5	K2(U)	Lecture, Group discussion	Seminar on outer measure, measurability and extension theorem Short test on outer measure and measurability
	2.	Measure and outer measure- Outer measure and measurability	3	K2(U)		
	3.	The extension theorem	7	K4(An)		

Course Focussing on Skill Development

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

Assignment :The L^P spaces (PPT)

Seminar Topic: Measure and outer measure

Sample questions

Part A

1. Each set consisting of a single point hasoutermeasure__________.

(a)1 (b)∞ (c)0 (d)φ

2. If $< f_n >$ converges to f pointwise, then $< f_n >$ is nearly uniformly convergent to f. This statement is by _____.

(a) Littlewood's first principle (b) Littlewood's second principle

(c) Littlewood's third principle (d)None of these

Part B

1. Let $\{A_n\}$ be a countable collection of sets of real numbers. Then prove that $m^*(\bigcup A_n) \leq \sum m^*(A_n)$.
2. State and prove Lebesgue Convergence theorem.

Part C

1. Prove that the outer measure of an interval is its length.

2. State and prove Vitali lemma.

Head of the Department **Course Instructor**

Dr.T.Sheeba Helen **Dr. A. JancyVini**

TEACHING PLAN

Department: Mathematics

Class: II M.Sc Mathematics

Title of the Course: Elective III (a)-Algebraic Number Theory and Cryptography

Semester: III

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
PM2034	4	-	-	4	6	90	25	75	100

Course Code: PM2034

Objectives:

1. To gain deep knowledge about Number theory

2. To study the relationship between Number theory and Abstract

3. To know the concepts of Cryptography.

Course Outcome

CO	**Upon completion of this course the students will be able to:**	**PSO addressed**	**CL**
CO - 1	Recall the basic results of field theory	PSO - 1	K1(R)
CO - 2	Understand quadratic and power series forms and the Jacobi symbol	PSO - 2	K_2(U)
CO - 3	Apply binary quadratic forms for the decomposition of a number into a sum of sequences	PSO - 3	K_3(Ap)
CO - 4	Determine solutions using Arithmetic Functions	PSO - 3	K_4(An)
CO - 5	Calculate the possible partitions of a given number and draw Ferrer's graph	PSO - 2	K_5(E)
CO - 6	Identify the public key using Cryptography	PSO - 4	K_4(An)

Teaching plan

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

Module	**Topic**	**Teaching Hours**	**Cognitive level**	**Pedagogy**	**Assessment/ Evaluation**
	Quadratic Reciprocity and Quadratic Forms.	5	K_2(U)	Introductory session, Group Discussion. PPT.	Evaluation through short test,MCQ, True/False.
	Quadratic Residues - Quadratic Reciprocity.	5	K_3(Ap)	Lecture using Chalk and talk, Problem-solving, Group Discussion.	Simple definitions, Recall steps,
	The Jacobi Symbol.	5	K_3(Ap)	Lecture using Chalk and talk, Problem-solving, Group Discussion.	solve problems, and explain
	Binary Quadratic Forms.	5	K_1(R)	Problem-solving, Demonstration.	MCQ, True/False.
	Equivalence and Reduction of Binary Quadratic Forms.	5	K_2(U)	Problem-solving, Group Peer tutoring.	Evaluation through short tests.
	Sum of Two Squares.	5	K_3(Ap)	Lectures using videos, Problem-solving.	Presentations
	Some Functions of Number Theory:	5	K_2(U)	Lectures using videos.	Evaluation through short

	Arithmetic functions.				tests.
	The Mobius Inversion Formula, Multiplicative functions.	5	K_2(U)	Introductory session, Group Discussion.	MCQ, True/False.
	Some Diophantine Equations: Pythagorean Triangles.	5	K_4(An)	PPT, Review.	Evaluation through short tests, Seminar.
	The Partition Function - Ferrers Graphs.	3	K_1(R)	Peer tutoring, Lectures using videos.	Evaluation through short tests.
	Formal Power Series.	4	K_2(U)	Lecture using Chalk and talk, Problem-solving.	Concept definitions
	Euler's Identity.	4	K_3(Ap)	Problem-solving, Group Discussion.	MCQ, True/False.
	Euler's Formula.	4	K_4(An)	Lecture using Chalk and talk, Problem-solving, Group Discussion.	Concept definitions, Seminar.
	Public Key Cryptography – Concepts of public key Cryptography.	5	K_2(U)	Peer tutoring, Lectures using videos.	Evaluation through short tests, Seminar.
	RSA –Discrete logarithm - Basic facts.	5	K_3(Ap)	Problem-solving, PPT.	Seminar.
	Elliptic curve cryptosystems.	5	K_4(An)	Lecture using Chalk and talk, Problem-solving, Group Discussion.	Concept explanations, Seminar.

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

Activities (Em/ En/SD):

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

Activities related to Cross Cutting Issues:

Assignment: Some Diophantine Equations: Pythagorean Triangles. (Online)

Seminar Topic: Concepts of public key Cryptography.

Sample questions (minimum one question from each unit)

Unit I:

Part A: Evaluate (2/61).

Part B: If p and q are distinct odd primes, then prove that $\left(\frac{p}{q}\right)\left(\frac{q}{p}\right) = (-1)\{\frac{p-1}{2}\}\{\frac{q-1}{2}\}$.

Part C: If Q is odd and Q > 0, then prove that $\left(\frac{-1}{Q}\right)$ = $(-1)^{\{(p-1)/2\}}$ and $\left(\frac{2}{Q}\right)$ = $(-1)^{\{(q-1)/2\}}$.

Unit II:

Part A: If two reduced forms are equivalent, they are-------------

Part B: Prove that there are only finitely many reduced forms having a given discriminant.

Part C: Let f, g and h be binary quadratic forms then prove that (i) f-f (ii) if f- g then g – f (iii) If f- g and g -h then f - h.

Unit III:

Part A: Find the value of $\tau(6)$.

Part B: if f(n) = $\sum_{d/n} \mu(d) F(\frac{n}{d})$ for every positive integer n, then prove that F(n) = $\sum_{d/n} f(d)$.

Part C: State and prove Mobius inversion formula.

Unit IV:

Part A: Determine the value of $q^o(5)$.

Part B: Prove that $\prod_{n=1}^{\infty}(1 + x^n) = \prod_{n=1}^{\infty}(1 + x^{2n-1})$.

Part C: For n ≥ 1, Prove that $p^d(n) = p^0(n)$.

Unit V:

Part A: Classical cryptography also called--------

Part B: Explain the analogy of El Gamal cryptosystem.

Part C: Determine the type of $y^2 = x^3 - x$ over F_{71}.

Head of the Department: Dr. T. Sheeba Helen

Course Instructor: Mrs. J C Mahizha