DEPARTMENT OF MATHEMATICS (S.F)

Vision

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

Mission

• To create opportunities which will ensure academic excellence in critical thinking, humanistic and scientific inquiry.

• To develop application-oriented courses with the necessary input of values.

• To create a possible environment for innovation, team spirit and entrepreneurial leadership.

• To form young women of competence, commitment and compassion

PG PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

POs	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
PEO2	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

PG 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 ecofriendly 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

I PG

Programme Specific Outcomes (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 I: Algebraic Structures
Semester : I
Course Code : MP231CC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP231CC1	6	1	-	4	7	90	25	75	100

Objectives

1. To introduce the concepts and to develop working knowledge on class equation, solvability of groups.
2. To understand the concepts of finite abelian groups, linear transformations, real quadratic forms

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	Students will be able to 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 (R) K2 (U)
CO - 2	Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules	PSO - 2	K2 (U)
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 nilpotent transformation relating nilpotence with invariants.	PSO - 3	K3 (A)
CO - 4	Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the	PSO - 3	K3 (A)

	elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation.		
CO - 5	Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation in Hermitian, unitary and normal	PSO - 4	K5 (E)

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

Unit	**Module**	**Topics**	**Teaching Hours**	**Cognitive level**	**Pedagogy**	**Assessment/ Evaluation**
I						
	1	Another Counting Principle – Definition of conjugate and normalizer, Lemma on conjugacy and normalizer.	3	K1 (R) K2 (U)	Introductory session, Lecture with illustration	Questioning, Recall steps, concept definitions, concept with examples
	2	Theorems and Corollary on conjugate class, problems of another counting principle	4	K5 (E)	Group Discussion, Lecture with illustration, Problem solving	Evaluation through short test, concept explanations, solve problems
	3	First part of Sylow's Theorem- First proof,	4	K3 (A)	Lecture with illustration,	Slip Test, concept explanations

		Corollary and Lemma on p-Sylow subgroup.			Peer tutoring	
	4	Second and Third part of Sylow's Theorem, problems of Sylow's Theorem	4	K5 (E)	Lecture with illustration, PPT, Problem solving	Quiz, concept explanations, solve problems
II						
	1	Direct Products-Definition of internal direct product, Lemma and Theorem on internal direct product, problems on direct products	3	K2 (U) K5 (E)	Introductory session, Lecture with illustration, Problem solving	Recall steps, Questioning, concept definitions, concept with examples, solve problems
	2	Finite Abelian Groups-Theorem based on direct	4	K3 (A)	Lecture with illustration, Group Discussion	Discussion, Quiz, concept explanations

		product of cyclic groups.				
	3	Modules- Definition and Examples, Definition of direct sum of submodules and cyclic R-module, Theorem and Corollary based on direct sum of submodules.	4	K2 (U)	Lecture with illustration	concept definitions, concept with examples
	4	Solvability by Radicals- Definition on solvable, Lemma and Theorem on solvable, problems on solvability by radicals	4	K5 (E)	Lecture with illustration, Problem solving	concept definitions, concept with examples, Evaluation through short test, solve problems
III						
	1	Triangular Form- Definition of	4	K2 (U)	Lecture with illustration	concept definitions, concept with

		similar and invariant, Lemma on invariant				examples, Questioning, Discussion
	2	Theorems on triangular, problems on triangular form	3	K5 (E)	Lecture with illustration, Peer tutoring, problem solving	concept explanations, Evaluation through short test, solve problems
	3	Nilpotent Transformations- Definition of index of nilpotence, invariant and cyclic, Lemma based on nilpotent, invariant	4	K3 (A)	Lecture with illustration, Group Discussion	concept definitions, concept explanations, Quiz
	4	Theorems based on index of nilpotence, similar, invariants	4	K3 (A)	Lecture with illustration, PPT	concept explanations, slip test
IV						
	1	Jordan Form – Definition, Lemma and Corollary on	4	K2 (U)	Lecture with illustration	concept definitions, concept with

		minimal polynomial				examples, Assignment
	2	Theorems and Corollary based on invariant, minimal polynomial, Jordan block, problems on Jordan Form	4	K5 (E)	Lecture with illustration, Peer tutoring, problem solving	concept explanations, Quiz, solve problems
	3	Rational Canonical Form- Definition of companion matrix, Lemma on companion matrix	3	K3 (A)	Lecture with illustration	concept explanations, Evaluation through short test
	4	Definition of rational canonical form, elementary divisors, characteristic polynomial, Theorems based on elementary	4	K2 (U)	Lecture with illustration, Group Discussion	concept definitions, concept explanations,

		divisors, similar				
V						
	1	Trace and Transpose-Definition, Lemma and Corollary based on trace, nilpotent, transpose	3	K2 (U)	Introductory session, Lecture with illustration	concept explanations, concept definitions, concept with examples
	2	Hermitian, Unitary and Normal Transformations- Definition, Lemma on unitary, Hermitian adjoint, normal	4	K3 (A)	Lecture with illustration	concept definitions, concept explanations, slip Test, seminar
	3	Theorems based on unitary, Hermitian, normal, problems on Hermitian	4	K5 (E)	Lecture with illustration, problem solving	concept explanations, Quiz, solve problems, seminar

	4	Real Quadratic Forms- Definition, Lemma and Theorem on congruent	4	K3 (A)	Lecture with illustration	concept definitions, Evaluation through short test, seminar

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: Jordan Form

Seminar Topic: Hermitian, Unitary and Normal Transformations

Sample questions

Part A

1. If $a\epsilon G$ then the normalizer of a in G, is the set N(a) = ______.
2. An R-module M is said to be _______ if there is an element $m_0 \in M$ such that every $m \in M$ is of the form $m = rm_0$ where $r \in R$.
   (a) Finitely generated (b) cyclic (c) direct sum (d) unital
3. State True or False: The subspace W of V is invariant under $T \in A(V)$ if WT⊂ W.
4. If $dim_F(V) = n$ then the _______ of T, is the product of its elementary divisors.
   (a) characteristic polynomial (b) companion matrix
   (c) rational canonical form (d) similar
5. Two real symmetric matrices A and B are ________ if there is a nonsingular real matrix T such that $B = TAT'$.

Part B

1. Prove that N(a) is a subgroup of G.
2. Prove that G is solvable if and only if $G^k = (e)$ for some integer k.
3. If M of dimension m is cyclic with respect to T then prove that the dimension of MT^k is m-k for all $k \leq m$.
4. Suppose that $V = V_1 \oplus V_2$ where V_1 and V_2 are subspaces of V invariant under T. Let T_1 and T_2 be the linear transformations induced by T on V_1 and V_2 respectively. If the minimal polynomial of T_1 over F is $p_1(x)$while that of $T_2$is $p_2(x)$ then prove that the minimal polnomial for T over F is the least common multiple of $p_1(x)$ and $p_2(x)$.
5. If $T \in A(V)$ then tr T is the sum of the characteristic roots of T.

Part C

1. Prove that the number of p-Sylow subgroups in G, for a given prime, is of the form 1+kp.
2. Prove that every finite abelian group is the direct product of cyclic groups.
3. If T$\in A(V)$ has all its characteristic roots in F then prove that there is a basis of V in which the matrix of T is triangular.
4. Prove that the elements S and T in $A_F(V)$ are similar in $A_F(V)$ if and only if they have the same elementary divisors.
5. Prove that the linear transformation T on V is unitary if and only if it takes an orthonormal basis of V into an orthonormal basis of V.

Head of the Department: **Dr.S.Kavitha**

Course Instructor**: Dr.C.Jenila**

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: 90 (Including instruction hours, assignments and tests)

Unit	**Module**	**Topic**	**Teaching Hours**	**Cognitive level**	**Pedagogy**	**Assessment/ Evaluation**
I	**Functions of Bounded Variation, Infinite Series**					
	1.	Definition of monotonic function connected and disconnected functions compact sets and examples	2	K1, K2	Recall the basic definitions	Questioning
	2.	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
	3.	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
	4.	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	4	K2, K5	Lecture	Question and answer

		functions of bounded variation				
	5.	Absolute and Conditional convergence, Definition – Absolutely convergent series, Example illustrating convergence does not imply absolute convergence, Dirichlet's test and Abel's test	3	K2, K4	Illustrative method and Discussion	Slip test
	6.	Rearrangement of series, Riemann's theorem on conditional convergent series	3	K4	Lecture	Class test
II	**The Riemann - Stieltjes integral**					
	1.	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	Questioning
	2.	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
	3.	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
	4.	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	4	K2	Lecture	Quiz method

		and lower Stieltjes sums of f with respect to α for the partition P, Theorem illustrating for increasing α, refinement of partition increases the lower sums and decreases the upper sums				
	5.	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**					
	1.	Integrators of bounded variation, Sufficient conditions for existence of Riemann – Stieltjes integrals	3	K2	Lecture	Short test
	2.	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
	3.	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
	4.	Riemann – Stieltjes integrals depending on a parameter, Differentiation under the integral sign	3	K3, K5	Lecture	Questioning

	5.	Interchanging the order of integration, Lebesgue's 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	4	K4	Interactive method	Slip Test
IV	**Infinite Series and Infinite Products, Power Series**					
	1.	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 PPT	Quiz
	2.	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
	3.	Cesaro Summability, Infinite products, Definition – infinite products, Cauchy condition for products	4	K2	Lecture	Concept Explanation
	4.	Power series, Definition – Power series, Multiplication of power series, Definition – Taylor's series	3	K3, K4	Lecture with chalk and talk	Slip Test
	5.	Abel's limit theorem, Tauber's theorem	3	K2, K4	Lecture Discussion	Q & A
V	**Sequences of Functions**					
	1.	Sequences of function – Pointwise convergence of sequence of function, Examples of sequences of real valued functions	3	K2	Introductory Session	Explain

	2.	Uniform convergence and continuity, Cauchy condition for uniform convergence	4	K2, K4	Lecture with illustration	Concept explanations
	3.	Uniform convergence of infinite series of functions, Riemann – Stieltjes integration, Non-uniform convergence and term-by-term integration	2	K3, K4	Seminar Presentation	Questioning
	4.	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): -Nil

Activities related to Cross Cutting Issues: -Nil

Assignment: Solving Exercise Problems

Seminar Topic: Double Sequence, Double Series, Rearrangement theorem for Double series, Sequence of functions- Pointwise, Uniform convergence

Sample questions

Part A

1. The function f is of bounded variation on [a,b] if f is _________ on [a,b].

2. Riemann integral is a special case of Riemann Stieltjes integral when $\alpha(x) =$ _____.

3. Say true or false: Assume that $\alpha \nearrow$ on [a,b]. If $f \in R(\alpha)$ on [a,b], then $f^2 \in R(\alpha)$ on [a,b].

4.Define a double sequence.

5.A sequence of functions $\{f_n\}$ is said to be ______________ on T if $\{f_n\}$ is pointwise convergent and uniformly bounded on T.

Part B

1.Prove that if f is monotonic on [a,b], then the set of discontinuities of f is countable.

2. Prove that the Riemann Stieltjes integral operates in a linear fashion on the integrator.

3.Prove that if f is continuous on [a,b] and if α is of bounded variation on [a,b], then $f \in R(\alpha)$ on [a,b].

4.State and prove Cauchy condition for products.

5.State and prove Dirichlet's test for uniform convergence.

Part C

1. State and prove Riemann's theorem on conditionally convergent series.
2. State and prove the formula for Integration by parts.

3.Assume that α is of bounded variation on [a,b]. Let V(x) denote the total variation of α on [a,x] if $a <$x$\leq b$, and let V(a)=0. Let f be defined and bounded on [a,b]. If $\in R(\alpha)$ on [a,b], then prove that $\in R(V)$ on [a,b].

4.State and prove Merten's theorem.

5. Assume that each term of $\{f_n\}$ is a real-valued function having a finite derivative at each point of an open interval (a,b). Assume that for at least one point x_0 in (a,b) the sequence $f_n(x_0)$ converges. Assume further that there exists a function g such that $f_n{}' \longrightarrow g$ uniformly on (a,b). Then prove that

a) There exists a function f such that $f_n \longrightarrow f$ uniformly on (a,b).

b) For each x in (a,b) the derivative$f'(x)$ exists and equals g(x).

J. Anne Mary Leema

Head of the Department

Dr. S.Kavitha

Course Instructor

Mrs.J.Anne Mary Leema

Ordinary Differential Equations

Department : **Mathematics(SF)**

Class : **I M.Sc**

Title of the Course : **Ordinary Differential Equations**

Semester : **I**

Subject code : **MP231CC3**

Course Code	L	T	P	S	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 variable coefficients and also with singular points.
2. To study existence and uniqueness of the solutions of first order differential equation.
3. To study mathematical methods for solving differential equations
4. Solve dynamical problems of practical interest.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO – 1	Establish the qualitative behaviour of solutions of systems of differentialequations.	PSO - 1	**K3**
CO – 2	Recognize the physical phenomena modelled by differential equations anddynamical systems.	PSO - 2	**K1**
CO – 3	Analyze solutions using appropriate methods and give examples.	PSO - 3	**K4**

CO – 4	Formulate Green's function for boundary value problems.	PSO - 3	**K5**
CO – 5	Understand and use the various theoretical ideas and results that underlie thematematics in course.	PSO - 3	**K2**

K1– Remember K2 - Understand K3 - Apply K4– Analyze K5–Evaluate

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

Unit	**Module**	**Topic**	**Teaching Hours**	**Cognitive level**	**Pedagogy**	**Assessment/ Evaluation**
I	**Linear equations with constant coefficients:**					
	1	Second order homogeneous Equations Introduction	4	K1(R)	Lecture using Chalk and talk ,Introductory session.	Simple definitions, Recall steps, Concept definitions
	2	Initial value problems	4	K2(U)	Group Discussion, Lecture using videos, Problem solving	Evaluation through short test, Concept explanations
	3	Linear dependence and independence	4	K2(U)	Peer tutoring, Lecture using videos	Suggest formulae, Solve problems, Explain.
	4	Wronskian and a formula for Wronskian Non-homogeneous equation of order two.	4	K3(Ap)	Lecture using Chalk and talk, Problem solving	Evaluation through short test, Seminar.
II	**Linear equations with constant coefficients:**					
	1	Homogeneous and non-homogeneous equation of order n	4	K2(U)	Lecture using Chalk and talk , Group Discussion, Mind mapping, Problem solving.	Problem-solving questions, Evaluation through short test.

	2	Initial value problems	3	K2(U)	Peer tutoring, Lecture using videos	Seminar, Problem-solving questions.
	3	Annihilator method to solve non-homogeneous equation	3	K2(U)	Lecture using Chalk and talk, Problem solving	Discussion, Debating or Presentations
	4	Algebra of constant coefficient operators	4	K3(Ap)	Lecture using videos, Problem solving	Evaluation through short test, Seminar
III	**Linear equation with variable coefficients:**					
	1	Initial value problems Existence and uniqueness theorems	5	K2(U)	Lecture using Chalk and talk	Concept explanations, Finish a procedure in many steps
	2	Solutions to solve a non-homogeneous equation	3	K5(E)	Lecture using videos	Evaluation through short test, Problem-solving questions
	3	Wronskian and linear dependence and reduction of the order of a homogeneous equation	3	K3(Ap)	Peer tutoring, Problem solving	Suggest formulae, Solve problems, MCQ, True/False
	4	Homogeneous equation with analytic coefficients and the Legendre equation	3	K2(U)	Problem solving Method, Demonstration, PPT	Suggest concept with examples, Suggest formulae, Solve problems, Explain
IV	**Linear equation with regular singular points:**					
	1	Euler equation	4	K3(Ap)	Lecture using Chalk and talk	Concept explanations, Finish a procedure in many steps.
	2	Second order equations with regular singular points	3	K2(U)	Peer tutoring, Problem solving	Suggest formulae, Solve problems, Explain, Problem-solving questions
	3	Exceptional cases	5	K5(E)	Group Discussion, Problem solving	Suggest formulae, Solve problems, MCQ, True/False
	4	Bessel Function	2	K3(Ap)	Group Discussion, Problem solving	Evaluation through short test, Seminar, Problem-solving questions

V	Existence and uniqueness of solutions to first order equations:					
	1	Equation with variable separated	3	K2(U)	Lecture using Chalk and talk	Concept explanations
	2	Exact equation method of successive approximations	3	K2(Ap)	Group Discussion, Problem solving	Problem-solving questions
	3	The Lipschitz condition	4	K2(U)	Problem solving Method, Peer tutoring	Problem-solving questions
	4	Convergence of the successive approximations and the existence theorem.	5	K3(Ap)	Group Discussion, Lecture using Chalk and talk	Problem-solving questions

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 : Wronskian and linear dependence and reduction of the order of a homogeneous equation

Seminar Topic: Linear equation with regular singular points.

Sample questions

Part A

1. The characteristic polynomial p(r) of the equation $L(y) = y'' + a_1y' + a_2y = 0$ is _____________.
   a) $a_1r^2 + a_2r + a_3 = p(r)$ b) $a_1r^3 + a_2r^2 + a_3r = p(r)$ c) $r^2 + a_1r + a_2 = p(r)$
2. For the n-th order equations $\|\phi(x)\|$ = ____________.
   a) $[|\phi(x)|^2 + \cdots + |\phi^{(n-1)}(x)|^2]^{1/2}$ b) $[|\phi(x)|^2 + \cdots + |\phi^{(n-1)}(x)|^2]^{1/3}$
   c) $[|\phi(x)|^2 + \cdots + |\phi^{(n-1)}(x)|^2]^{1/4}$

3. If $\phi_1, \phi_2, \dots, \phi_n$ are n solutions of L(y) = 0 on an interval I, they are linearly independent there if , and only if,

   a) W($\phi_1, \phi_2, \dots, \phi_n$) = 0 b) W($\phi_1, \phi_2, \dots, \phi_n$) $\neq$ 0 c) W($\phi_1, \phi_2, \dots, \phi_{n-1}$) = 0

4. The Legendre equation is ___________.

   a) L(y) = $(1-x^2)$" $-2xy$' + $\alpha(\alpha+1)y$ = 0 b) L(y) = $(1+x^2)$" $-2xy$' + $\alpha(\alpha+1)y$ = 0 c) L(y) = $(1-x^2)$" + $2xy$' + $\alpha(\alpha+1)y$ = 0

5. The Bessel's equation is ____________.

   a) $x^2y" - xy' + (x^2 - \alpha^2)y = 0$ b) $x^2y" - xy' - (x^2 - \alpha^2)y = 0$

   c) $x^2y" + xy' + (x^2 - \alpha^2)y = 0$

Part B

1. Prove that the infinite series involved in the definition of K_n converges for $|x| < \infty$.
2. Solve $\cos x\, cos^2 y\, dx - \sin x \sin 2y\, dy = 0$
3. Let α, β be any two constants, and let x_0 be any real number. On any interval I containing x_0 there exists at most one solution ϕ of the initial value problem
   L(y)=0, y(x_0) $= \alpha$, y'(x_0) $= \beta$.
4. Compute three linearly independent solutions for the equation y''' – 4y' = 0.
5. One solution of $x^2y" - 2y = 0$ on $0 < x < \infty$ is $\phi_1(x) = x^2$. Find all solutions of $x^2y" - 2y = 2x - 1$ on $0 < x < \infty$.

Part C

1. If $\phi_1, \phi_2, \dots, \phi_n$ are n solutions of L(y) = 0 on an interval I, they are linearly independent there if , and only if, W($\phi_1, \phi_2, \dots, \phi_n$) $\neq$ 0 for all x in I.
2. Second order equations with regular singular points – the general case.
3. Let M, N be two real-valued functions which have continuous first partial derivatives on some rectangle R: $|x - x_0| \leq$ a, $|y - y_0| \leq$ b. then the equation M(x, y) + N(x, y)y' = 0 is exact in R if, and only if, $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ in R.
4. Let ϕ be any solution of L(y) = y" + a_1y' + a_2y = 0 on an interval I containing a point x_0. Then for all x in I $\|\phi(x_0)\|e^{-k|x-x_0|} \leq \|\phi(x)\| \leq \|\phi(x_0)\|e^{k|x-x_0|}$ where $[|\phi(x)|^2 + |\phi'(x)|^2]^{1/2}$, k= 1 + $|a_1|$ + $|a_2|$.
5. Consider the equation with constant coefficients L(y) = P(x)e^{ax} where P is the polynomial given by P(x) = $b_0x^m + b_1x^{m-1} + \dots + b_m$, ($b_0 \neq 0$). Suppose a is the root of the characteristic polynomial p of L of multiplicity j. then there is a unique solution $\psi(x) = x^j(c_0x^m + c_1x^{m-1} + \dots + c_m)e^{ax}$, where $c_0, c_1, \dots, c_m$ are constants determined by the annihilator method.

Head of the Department: Dr.S.Kavitha Course Instructor: Ms.P.C.Priyanka Nair

Teaching Plan

Department : Mathematics
Class : I M.Sc Mathematics
Title of the Course : Elective -I Graph Theory and Application
Semester : I
Course Code : MP231DE1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP231DE1	3	1	-	3	4	60	25	75	100

Objectives

1. To help students to understand various parameters of Graph Theory with applicants.
2. To stimulate the analytical mind of the students , enable them to acquire sufficient knowledge and skill in the subject that will make them component in various areas of Mathematics.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	Recall the basic concepts of graph theory and know its various parameters.	PSO - 1	K1(R)
CO - 2	Understand the many results derived on the basis of known parameters.	PSO - 2	K2(U)
CO - 3	Apply the concepts to evaluate parameters for the family of graphs.	PSO - 4	K3(A)&K4(An)
CO - 4	Analyze the steps of various theorems and know its applications.	PSO - 3	K1(R)&K4(An)
CO - 5	Create a graphical model for the real world problem using the relevant ideas.	PSO - 4	K6(C)

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	Definition of tree & examples, theorems.Cut edges definitions, examples & Theorems.	3	K2(U)	Lecture with Illustration	Evaluation through test
	2.	Definition of bond ,examples, theorems, Definition of cotree & examples, theorems.	2	K1(R)	Lecture with Illustration	Recall concept definitionand steps
	3.	Cut vertices: Definition & Examples, Theorems, Corollary	2	K3(Ap)	Lecture with Examples	Suggest concept with examples,
	4.	Definition of k-connected, k-edge connected & examples,theorems	2	K4(An)	Discussion with Illustration	Differentiate between various ideas
	5	Blocks : Definitions & examples, theorems, corollary. Contruction of reliable communication network	2	K2(U)	Lecture with Illustration	Evaluation through short test
II						
	1	Euler tour: Definition & Examples, Theorems, corollary	2	K6(C)	Lecture with PPT	Check knowledge in Tour
	2	Hamilton cycles: Definition & Examples, Theorems, lemma, corollary	4	K3(A)	Lecture with illustration	Draw different cycles
	3	The Chinese postman problem, Fleury's algorithm, theorems,problems	5	K2(U)	Lecture using videos	Evaluation through Assessment Test
III						

	1	Matching: Defition & examples, M-saturated, Maximum matching,M-alternating path, M-augmenting path; definitions & examples,theorems	4	K2(U)	Lecture with PPT Illustration	Evaluation through Quiz
	2	k-edge coloring,k-edge colourable, k-edge chromatic : Definitions, examples, lemma, theorems, Edge chromatic number	3	K3(A)	Lecture with Illustration	Suggest concept with examples
	3	Bipartite graph: Definition & example, Vizing's theorem	2	K6(C)	Lecture with examples	Check knowledge through Assignmen t
IV						
	1	Independent set, maximum independent set : Definitions, examples & theorems, corollary	2	K2(U)	Lecture withPPT Illustration	Evaluation throughMC Q, Short test
	2	Edge covering, edge independence number: Definitions &examples theorems	2	K2(U)	Lecture and group discussion	Evaluation through Quiz
	3	k-vertex colouring,k- vertex colourable: Definitions, examples, theorems, corollary	2	K4(An)	Lecture with Illustration	Draw different graph
	4	k-chromatic graph, k-critical subgraph,clique: Definitions,examples,theor ems, corollary	3	K2(U)	Lecture with Illustration	Evauation through Test
	5	Brook's theorem Subdivision: definition, Hajo's conjecture, theorem	2	K3(A)	Lecture	Explain concept with examples
V						
	1	Definition: embeddable, planar embedding,plane graph,theorems,examples	3	K4(An)	Lecture withPPT Illustration	Explain concept with examples
	2	Euler's formula: Theorems,corollary	3	K5(E)	Lecture with Illustration	Evaluation through Assessmen ttest

	3	Kuratowski's theorem, Five colour theorem	2	K3(A)	Lecture with PPT Illustration	Evaluation through Sliptest
	4	Four colour conjecture	2	K3(A)	Lecture with PPT	Explain concept with examples

Course Focussing on Employability/ Entrepreneurship/ Skill Development : Employability

Activities (Em/ En/SD): group discussion,seminar,Assignment, draw a graph

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

Activities related to Cross Cutting Issues :Nil

Assignment : Planar Graphs

Seminar Topic: Vertex colouring

Sample questions

Part A

1. A connected acyclic graph is -----------------
2. A Chinese postman problem is finding a --------------------
3. G is k-edge chromatic if $\chi'(G)$=$-----$.

4. A subset S of V is called an -------------- if no two vertices of S are adjacent in G

   i) dependent set ii) independent set

5 . Every planar graph is ----------------------------

Part B

1. Let T be a spanning tree of a connected graph G and let e be any edge of T. Then

   i) the cotree :T contains no bond of G

   ii) T+e contains a unique bond of G

2. If G is a Hamiltonian then for every nonempty proper subset S of V $\omega(G-S) \leq |S|$
3. If G is bipartite then χ'=Δ.

4. A set $S \subset V$ is an independent set of G if and only if V\S is a covering of G.
5. A graph G is embeddable in the plane if and only if it is embeddable on the sphere.

Part C

1. Show that $k \leq k' \leq \delta$
2. If G is a simple graph with $\nu \geq 3$ and $\delta \geq \frac{\nu}{2}$ then G is a Hamiltonian.
3. A matching M in G is a maximum matching if and only if G contains no M- augmenting path.
4. Let G be a k- critical graph with 2-vertex cut {u,v}. Then i) G=$G_1 \cup G_2$, where G_1 is a {u,v}-component of type I (i=1,2), and ii) both $G_1 + uv$ and $G_2 . uv$ are k- critical.
5. If G is connected plane graph ,then $\nu - \epsilon + \varphi = 2$

Head of the Department — Course Instructor

Dr. S. Kavitha — Dr.J.Nesa Golden Flower

Teaching Plan

Department : Mathematics S.F
Class : I M.Sc Mathematics
Title of the Course : Elective II : Discrete Mathematics
Semester : I
Course Code : MP231GE1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MP231GE1	4	1	-	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:		PSO addressed	Cognitive
CO1	Remember and interpret the basic concepts in permutations and combinations and distinguish between distribution of distinct and non-distinct objects	PO1 & PO2	**U**
CO2	Interpret the recurrence relation and generating functions and evaluate by using the technique of generating functions	PO3 & PO5	A
CO3	Solve the problems by the principle of inclusion and exclusion	PO6	Ap
CO4	To prove the basic theorems in Boolean Algebra and to develop the truth table for a Boolean expression	PO4	Ap
CO5	Differentiate between variety of lattices and their properties	PO5 & PO7	A

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 Chalk and talk,	Home work

					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						
	1.	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
	2.	The general formula	5		Lecture using Chalk and talk, Problem solving	Brain Storming, Problem solving
	3.	Derangements	5	K3(Ap)	Lecture using Chalk and talk, Problem solving	Home work
IV						
	1.	Boolean Algebra: Introduction	3	K2(U)		Brain Storming
	2.	Basic Theorems on Boolean Algebra	3	K2(U)	Lecture using Chalk and talk, Problem solving, Peer tutoring	Brain Storming, Problem solving
	3.	Duality Principle	3	K2(U)	Lecture using Chalk and talk, Problem solving, Peer tutoring	Slip test, Assignments
	4.	Boolean Functions	3	K2(U)	Lecture using Chalk and talk, Peer tutoring	Oral test
	5.	Applications of Boolean algebra	3	K3(Ap), K4(An)	Lecture using Chalk and talk, Problem	Brain Storming, Problem solving

					solving, Peer tutoring	
V						
	1.	Posets and Lattices: Introduction	2	K2(U)	Lecture using Chalk and talk, Peer tutoring	Class test
	2.	Totally Ordered Set or Chain	3	K2(U)	Lecture using Chalk and talk, Peer tutoring	Problem solving, Home work
	3.	Product Set and Partial Order Relation	3	K3(Ap)	Lecture using Chalk and talk, Peer tutoring	Slip test, Assignments
	4.	Hasse Diagrams of Partially Ordered Sets	3	K2(U)	Graphical representation, Demonstration	Suggest formulae, Solve problems, Home work
	5.	Lattice- Duality	2	K4(An)	Lecture using Chalk and talk, Problem solving, Peer tutoring	Slip test, Assignments
	6.	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

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

Activities related to Cross Cutting Issues: Nil

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 $1, 3, 3^2, 3^3, \dots, 3^n$

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

Dr.S.Kavitha

Course Instructor

Ms.Y.A.Shiny

II PG

PROGRAMME SPECIFIC OUTCOME (PSOs)

PSO No.	Upon completion of the M.Sc. Degree Programme, the graduates will be able to:	PO addressed
PSO - 1	utilize the knowledge gained for entrepreneurial pursuits.	PO 1
PSO - 2	sharpen their analytical thinking, logical deductions and rigour in reasoning.	PO 2
PSO - 3	use the techniques, skills and modern technology necessary to communicate effectively with professional and ethical responsibilities.	PO 3
PSO - 4	Understand the applications of mathematics ina global economic environmental and societal context.	PO 4

Teaching Plan

Department : Mathematics (SF)
Class : II M.Sc. Mathematics
Title of the Course : 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	25	75	100

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 (R)
CO - 2	express the fundamental concepts of field theory, Galois theory	PSO - 2	K2 (U)
CO - 3	demonstrate the use of Galois theory to construct Galois group over the rationals	PSO - 3	K5 (E)
CO - 4	distinguish between field theory and Galois theory	PSO - 3	K3 (A)
CO - 5	interpret distributivity and modularity and apply these concepts in Boolean Algebra	PSO - 4	K3 (A)
CO - 6	understand the theory of Frobenius Theorem	PSO - 2	K2 (U)
CO - 7	develop the knowledge of lattices and establish new relationships in Boolean Algebra	PSO - 1	K6 (C)

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

Unit	Module	Topics	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1	Extension field - Definition, Finite extension- Theorems on finite extension	4	K2 (U)	Introductory session, Lecture with illustration, Problem solving	Questioning, Recall steps, concept definitions, concept with examples
	2	Theorems and corollary on algebraic over Fields and understand about subfields of an extension	4	K5 (E)	Group Discussion, Lecture with illustration, Problem solving	Evaluation through short test, concept explanations
	3	Adjunction of an element to a field, subfields, Theorems.	4	K3 (A)	Lecture with illustration, Peer tutoring	Slip Test, concept explanations
	4	Algebraic extension, Theorems on algebraic extension, algebraic number, transcendental number	3	K3 (A)	Lecture with illustration, PPT	Quiz, concept explanations
II						

	1	Definition-root, Remainder theorem, Definition-multiplicity	3	K2 (U)	Introductory session, Lecture with illustration, Problem solving	Recall steps, Questioning, concept definitions, concept with examples, solve problems
	2	Theorems based on roots of polynomials, Corollary and lemma based on roots of polynomials.	4	K3 (A)	Lecture with illustration, Group Discussion	Discussion, Quiz, concept explanations
	3	Definition-splitting field. Theorems based on isomorphism of fields, Theorems based on splitting field of polynomials	4	K5 (E)	Lecture with illustration, Problem solving	concept definitions, concept with examples, Problem solving questions
	4	Definition-derivative, Lemmas on derivative of polynomials, Simple extension,	3	K2 (U)	Lecture with illustration, Problem solving	concept definitions, concept with examples, Evaluation

		Theorems on simple extension.				through short test
III						
	1	Fixed Field - Definition, Theorems based on Fixed Field, Group of Automorphism	4	K2 (U)	Lecture with illustration, Problem solving	concept definitions, concept with examples, Questioning,, Discussion
	2	Theorems based on group of Automorphism , Finite Extension, Normal Extension	5	K2 (U)	Lecture with illustration, Peer tutoring	concept explanations, Evaluation through short test
	3	Theorems based on Normal Extension, Galois Group, Theorems based on Galois Group	4	K3 (A)	Lecture with illustration, Group Discussion	concept explanations, Quiz
	4	Galois Group over the rationals, Theorems based on Galois Group over the rationals, Problems based on Galois Group	4	K3 (A)	Lecture with illustration, PPT	concept explanations

		over the rationals				
IV						
	1	Finite Fields – Definition, Lemma-Finite Fields, Corollary-Finite Fields	4	K5 (E)	Lecture with illustration, Problem solving	concept with examples, Assignment
	2	Theorems based on Finite Fields, Wedderburn's Theorem on finite division ring	4	K3 (A)	Lecture with illustration, Peer tutoring	concept explanations, Quiz
	3	Wedderburn's Theorem, Wedderburn's Theorem-First Proof	4	K3 (A)	Lecture with illustration	concept explanations, Evaluation through short test
	4	A Theorem of Frobenius-Definitions, Algeraic over a field, Lemma based on Algeraic over a field	3	K2 (U)	Lecture with illustration, Group Discussion	concept definitions, concept explanations,
V						
	1	Partially ordered set-Definitions, Theorems based on	3	K2 (U)	Introductory session, Lecture with illustration	concept explanations, concept with examples, Seminar

		Partially ordered set				
	2	Totally ordered set, Lattice, Complete Lattice	4	K3 (A)	Lecture with illustration	Slip Test, Seminar
	3	Theorems based on Complete lattice, Distributive Lattice	3	K2 (U)	Lecture with illustration	concept explanations, Quiz, Seminar
	4	Modular Lattice, Boolean Algebra, Boolean Ring	4	K3 (A)	Lecture with illustration	Evaluation through short test, Seminar

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

Activities (SD): Find the degree of splitting field of the polynomial.

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: Lattices and Boolean algebras

Sample questions

Part A

1. The degree of an extension field K over a field F is _______.
2. If p(x) ∈ F[x], then an element α lying in some extension field of F is called a _______ of p(x) if p(α) = 0 .
   (b) field (b) extension field (c) irrational field (d) root

3. State True or False: The fixed field of G is a subfield of K.
4. The _______ group of nonzero elements of a finite field is cyclic.

(a) commutative (b) cyclic (c) finite (d) multiplicative

5. Assertion (A): A lattice homomorphism is order preserving.

Reason (R): Define a homomorphism of a lattice L into a lattice L' to be a map $a \rightarrow a'$ such that $(a \vee b)' = a^1 \vee b'$ and $(a \wedge b)' = a^1 \wedge b'$.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.

(c) A is true and R is false.

(d) Both A and R are false.

Part B

1.Prove that, 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.State and prove Remainder theorem.

3. If K is a finite extension of F, then G(K,F) is a finite group and its order o(G(K,F)), satisfies 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 D = C.
5. Show that any totally ordered set is a distributive Lattice.

Part C

1. If L is a finite extension of K and if K is a finite extension of F then L is a finite extension of F. Moreover [L:F]=[L:K] [K:F].

2.If F is of characteristic 0 and if a, b are algebraic over F, then there exist an element C ∈ F(a, b) such that F(a, b) = F(c).

3.State and prove fundamental theorem of Galois theory.

4.Let K be a field and let G be a finite subgroup of the multiplicative group of nonzero elements of K. Then G is a cyclic group.

5. A lattice L is modular if and only if whenever a ≥ b and $a \wedge c = b \wedge c$ and $a \vee c = b \vee c$ for some c in L, then a = b.

Head of the Department: Dr.S.Kavitha

Course Instructor: Dr.C.Jenila

Teaching Plan

Department : Mathematics S.F
Class : II M.Sc Mathematics
Title of the Course : Core X: Topology
Semester : III
Course Code **: PM2032**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
PM2032	**6**	**-**	**-**	**5**	**6**	**90**	**25**	**75**	**100**

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(U)
CO - 2	construct a topology on a set so as to make it into a topological space	PSO - 4	K3(A)
CO - 3	distinguish the various topologies such as product and box topologies and topological spaces such as normal and regular spaces.	PSO - 3	K2(U)
CO - 4	compare the concepts of components and path components, connectedness and local connectedness and countability axioms.	PSO - 2	K5(E)
CO - 5	apply the various theorems related to regular space, normal space, Hausdorff space, compact space to other branches of mathematics	PSO - 1	K3(A)
CO - 6	construct continuous functions, homeomorphisms and projection mappings.	PSO - 4	K6(C)

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	Definition of topology, discrete and indiscrete topology, finite complement topology, Basis for a topology and examples, Comparison of standard and lower limit topologies	3	K2(U)	Lecture with Illustration	Evaluation through test
	2.	Order topology: Definition & Examples, Product topology on XxY: Definition & Theorem	3	K1(R)	Lecture with Illustration	Recall concept definition and steps
	3.	The Subspace Topology: Definition & Examples, Theorems	3	K3(Ap)	Lecture with Examples	Suggest concept with examples, formula
	4.	Closed sets: Definition & Examples, Theorems, Limit points: Definition Examples & Theorems , Hausdorff Spaces: Definition & Theorems	5	K4(An)	Discussion with Illustration	Differentiate between various ideas
	5	Continuity of a function: Definition, Examples, Theorems, Homeomorphism: Definition & Examples, Rules for constructing continuous function, Pasting lemma & Examples, Maps into products	5	K2(U)	Lecture with Illustration	Evaluation through short test
II						
	1	The Product Topology: Definitions,Comparison	3	K6(C)	Lecture with PPT	Check knowledg

		of box and product topologies, Theorems related to product topologies, Continuous functions and examples				e in topologies
	2	The Metric Topology: Definitions and Examples, Theorems, Continuity of a function, The sequence lemma, Constructing continuous fuctions, Uniform limit theorem, Examples and Theorems	5	K3(A)	Lecture with illustration	Solve problems
	3	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.	5	K2(U)	Lecture using videos	Evaluation through Assessment Test
	4	Components and Local Connectedness: Definitions, Path components, Locally connected, Locally path connected: Definitions and Theorems	3	K3(A)	Group Discussion	Suggest concept with examples, formula
III						
	1	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	K2(U)	Lecture with PPT Illustration	Evaluation through Quiz
	2	Compact Subspaces of the Real Line: Theorem, Characterize compact subspaces of R^n, Extreme	3	K3(A)	Lecture with Illustration	Suggest formulae with examples

		value theorem, The Lebesgue number lemma, Uniform continuity theorem				
	3	Limit Point Compactness: Definitions, Examples and Theorems, Sequentially compact	2	K6(C)	Lecture with examples	Check knowledge through Assignment
	4	Complete Metric Spaces: Definitions, Examples and Theorems, Isometric embedding	3	K5(E)	Group Discussion	Formative Assessment Test
	5	Compactness in Metric spaces: Totally bounded, Pointwise bounded, Equicontinuous, Definitions, Lemmas, Theorems	3	K3(A)	Lecture and group discussion	Evaluation through Class test
IV						
	1	Local compactness: Definition & Examples, Theorems	3	K2(U)	Lecture with PPT Illustration	Evaluation through MCQ, Short test
	2	First Countability axiom, Second Countability axiom: Definitions, Theorems, Dense subset: Definitions & Theorem, Examples, Lindelof space : Definition , Examples	3	K2(U)	Lecture and group discussion	Evaluation through Quiz
	3	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	K4(An)	Lecture with Illustration	Problem solving
	4	Normal Spaces: Theorems and Examples	2	K2(U)	Lecture with Illustration	Evauation through Test
	5	Urysohn lemma	3	K3(A)	Lecture	Explain concept

						with examples
V						
	1	Urysohnmetrization theorem, Imbedding theorem	3	K4(An)	Lecture with PPT Illustration	Explain concept with examples
	2	Tietze extension theorem	3	K5(E)	Lecture with Illustration	Evaluation through Assessment test
	3	The Tychonoff Theorem	3	K3(A)	Lecture with PPT Illustration	Evaluation through Slip test
	4	The Stone-CechCompactification: Defintions, Lemmas, Theorems	3	K3(A)	Lecture with PPT	Explain concept with examples

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Course Focussing on: Skill Development

Activities: Comparison of box and metric topology, group discussion ,seminar

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

Activities related to Cross Cutting Issues: Nil

Assignment : Connected subspace of the Real Line

Seminar Topic: Countable Spaces

Sample questions

Part A

2. The standard topology on the real line is. . . . . .
2. A set U is open in metric topology induced by d iff

(i) For each $y \in U$, there is $\delta > 0$ such that $B_d(y,\delta) \subset U$

(ii) For each $y \in U$, each $\delta > 0$ such that $(y,) \subset U$

(iii) For some $y \in U$,there is$\delta > 0$ suchthat $B(y,\delta) \subset U$

(iv) For some $y \in U$, each $\delta > 0$ such tha t$(y,\delta) \subset U$

3. Say true or false

   Every compact subspace of a Hausdorff space is closed.

4. When will you say a space is second countable?

5 . An arbitrary product of compact spaces is compact in the product topology is the statement of

   a) Tietze extension theorem b)Tychonoff theorem c) Imbedding theorem.

Part B

1. Let$A$ be a subset of the topological space X.Then prove that $x \in \bar{A}$ if and only if every

   Open set U containing intersects A.

2. If each space X_α is a Hausdorff space, then show that $\prod$ is a Hausdorff space in

   Both the box and product topologies.

3. State and prove uniform continuity theorem.

4. Show that every compact Hausdorff space is normal.

5. If $\subset X$ and $f: A \rightarrow Z$ is a continuous map of A into the Hausdorff space Z. Then prove that there is at most one extension of f to a continuous function$g$:$\bar{A} \rightarrow Z$.

Part C

6. If A is a subspace of X and B is subspace of Y,then prove that the product topology on $A \times B$ is same as the topology $A \times B$ inherits as a subspace of $X \times Y$.

2. State and prove the intermediate value theorem.

3. Let X be a metrizable space. Then prove that the following are equivalent:

   (i) X is compact.

   (ii) X is limit point compact.

   (iii) X is sequentially compact

4. State and prove Urysohn Lemma.

5. State and prove Tietze extension theorem.

Head of the Department: Course Instructor:

Dr. S. Kavitha **Dr.J.Nesa Golden Flower**

Teaching Plan

Department : Mathematics (S.F)
Class : II M.Sc Mathematics
Title of the course : Measure Theory and Integration
Semester : III
Course Code : PM2033

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MC2053	5	-	-	5	5	90	25	75	100

Objectives:

1.To generalize the concept of integration using measures.

2. To develop the concept of analysis in abstract situations

3. To apply Measures and Lebesgue integrals to various Measurable sets and Measurable functions

4.To compare the different types of measures and signed measure

Course Outcomes:

CO	Upon completion of this course the students willbe able to :	PSO addressed	Cognitive level
CO-1	Define the concept of measures and Vitali covering and recall some properties of convergence of functions,	PSO – 1	U
CO-2	Cite examples of measurable sets , Measurable functions, Riemann integrals, Lebesgue integrals.	PSO – 3	A
CO-3	Apply measures and Lebesgue integrals to various measurable sets and Measurable functions	PSO – 2	Ap
CO-4	Apply outer measure, Differentiation and integration to intervals, functions and Sets.	PSO – 2	Ap
CO-5	Compare the different types of Measures and Signed measure Construct Lp Spaces and Outer Measurable Sets.	PSO – 3	A

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

Unit	Section	Topics	Lecture Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Lebesgue Measure**					
	1.	Lebesgue Measure, Introduction.Definitions and examples of Lebesgue Measure .	4	K2(U)	Lecture using Chalk and talk, Introductory session, Peer tutoring, Lecture using videos.	Simple definitions, Recall basic concepts on measure, Examples
	2.	Definitions of Outer Measure and related theorems	3	K2(U)	Group discussion	Evaluation through short test, concept explanations
	3.	Measurable Sets	3	K3(Ap)	Lecture using PPT	Suggest idea/concept explanation with examples
	4.	Measurable functions	2	K3(Ap)	Lecture using videos	Check Knowledge in specific.
	5.	Littlewood's three principles	3	K3(Ap)	Lecture with Illustration	Differentiate between Measure and Outer Measure
II	**The Lebesgue integral**					
	1.	Definitions and Theorems of The Lebesgue integral	3	K2(U)	Lecture using Chalk and talk	Examples
	2	Definitions and Theorems of The Riemann Integral	4	K2(U)	Lecture with Illustration	Check Knowledge in specific
	3	The Lebesgue integral of a bounded function over a set of finite measure	3	K3(Ap)	Lecture and Group discussion	Test
	4	The integral of a non-negative function	3	K3(Ap)	Lecture using Chalk and talk	Assignment
	5.	The general Lebesgue integral	2	K2(U)	To prove the general Lebesgue integral	Evaluation through asking questions
III	**Differentiation and Integration**					
	1.	Introduction of Differentiation and Integration	2	K2(U)	Lecture with PPT	Differentiate between Differentiation and integration
	2.	Differentiation of monotone functions	3	K1(R)	Lecture with Illustration	Recall different types of functions
	3.	Functions of bounded variation	3	K1(R)	Group discussion	Test

	4.	Differentiation of an integral	4	K2(U)	Lecture and Group discussion	Test
	5.	Absolute continuity.	3	K1(R)	Lecture using Chalk and talk	Evaluation
IV	**Measure and integration**					
	1.	Introduction of Measure and integration	4	K2(U)	Lecture using Chalk and talk	Recall definitions and basic concepts
	2.	Measure spaces	2	K1(R)	PPT	Assignment
	3.	Measurable functions	2	K2(U)	Lecture with Illustration	Recall different types of functions
	4.	Integration	3	K3(Ap)	Lecture with Illustration	Concept explanation with examples
	5.	General Convergence Theorems	2	K1(R)	Group discussion	Evaluation through short test, concept explanations
	6.	Signed measures.	2	K2(U)	Lecture using Chalk and talk	Evaluation
V	**The L_P spaces**					
	1.	Introduction of The L_P spaces	5	K2(U)	Group discussion	Q& A
	2.	Measure and outer measure	4	K1(R)	Group discussion	Assignment
	3.	Outer measure and measurability	3	K3(Ap)	Lecture with Illustration	Test
	4.	The extension theorem	3	K3(A)	Lecture with PPT	Evaluation

Course Focussing on Employability/Entrepreneurship/Skill Development : Employability

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

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

Activities related to Cross Cutting Issues: Nil

Assignment: General Convergence Online Assignment

Seminar Topic: Measure and Outer Measure

Sample questions

Part A

1. If A,B ∈ μ and AcB then ………
2.Outer Measure of a Countable set is ……………
3. A linear combination of the set E is said to be………..
4.If f is absolute continuity on [a,b] then it is of …………… on [a,b]
5.Every σ- finite measure is………..

Part B

1.State and Prove monotonicity property
2.State and Prove Fatou's lemma
3.Show that function f is bounded variation on [a,b] iff f is the difference of two monotone real valued function on [a,b]
4.Let f be an increasing real valued function [a,b].Then f is differential a.e.prove that the f' is measurable
5.If $E_i \in \beta$, μE_1<∞ and $E_i \supset E_{i+1}$ then $\mu(E_i)$ = μE_n

Part C

1. Prove that the outer measure of an interval is its length.
2.Prove that every boral set is measurable. In particular each open set and each closed set is measurable.
3.State and Prove Bounded Convergence Theorem
4.Show that if f is absolute continuity on [a,b] then it is of bounded variation on [a,b]
5. State and Prove The extension theorem

Head of the Department
Dr.S.Kavitha

Course Instructor
Ms.Y.A.Shiny

Teaching Plan

Department : **Mathematics S.F.**
Class : **II M.Sc Mathematics**
Title of the Course : **Elective III: Algebraic Number Theory and Cryptography**
Semester : **III**
Course Code : **PM2034**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
PM2034	4	2	-	4	6	90	25	75	100

Objectives

- To gain deep knowledge about Number theory
- To study the relation between Number theory and Abstract Algebra.
- To know the concepts of Cryptography.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	Recall the basic results of field theory	PSO - 1	K1(R)
CO - 2	Understand quadratic and power series forms and Jacobi symbol	PSO - 2	K2(U)
CO - 3	Apply binary quadratic forms for the decomposition of a number into sum of sequences	PSO - 3	K3(AP)
CO - 4	Determine solutions using Arithmetic Functions	PSO - 3	K3AP)
CO - 5	Calculate the possible partitions of a given number and draw Ferrer's graph	PSO - 2	K4(An)
CO-6	Identify the public key using Cryptography	PSO - 4	K4(An)

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

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	**Quadratic Residues-** Definition and examples, Legendre symbol definition and Theorem	2	K2(U)	Lecture using Chalk and talk, Group Discussion, Problem solving, Lecture using PPT	Recall basic definitions on Number theory, Solving problems
	2.	**Lemma of Gauss**, Theorem on Legendre symbol	3	K1(R)	Lecture using PPT, Problem solving	Evaluation through short test, concept explanations, Solving problems
	3.	**Quadratic reciprocity-** The Gaussian reciprocity law, Theorem on Quadratic reciprocity	3	K3(Ap)	Lecture using Chalk and talk, Lecture using PPT, Problem solving.	MCQ, Solving problems, Questioning and Home Assignment
	4.	**The Jacobi symbol-** Definition , examples and Theorems	3	K4(An)	Lecture using Chalk and talk, Lecture using PPT, Problem solving	Evaluation through short test, Seminar, MCQ and Home Assignment
II	**Binary Quadratic forms**					
	1.	**Binary Quadratic forms-** Definition, examples and Theorems	3	K2(U)	Lecture using PPT, Group Discussion, Problem solving	Concept explanations with examples, True / False
	2.	**Equivalence and Reduction of Binary Quadratic forms-** Definition and Theorems	4	K2(U)	Lecture using PPT, Group Discussion, Problem solving	Class test, Simple definitions ,examples, MCQ and Home Assignment

	3.	**Sum of two squares-** Theorems on sum of two squares	4	K3(AP)	Lecture using Chalk and talk, Lecture using PPT, Problem solving	MCQ, Recall steps, Questioning and Home Assignment
III	**Some Functions of Number Theory**					
	1.	**Arithmetic functions-** Definition, examples and Theorems	3	K3(AP)	Lecture using Chalk and talk, Lecture using PPT, Problem solving	Evaluation through short test, concept explanations
	2.	**The Mobius Inversion Formula-** Definition, Theorems and Problems	3	K3(AP)	Lecture using Chalk and talk, Lecture using PPT, Problem solving	Peer teaching, MCQ, Recall steps, Questioning and Home Assignment
	3.	**Some Diophantine Equations -** Examples and Theorems	3	K4(An)	Lecture using Chalk and talk, Lecture using PPT, Problem solving	Simple definitions ,examples, Evaluation through asking question
	4.	**Pythagorean Triangle-** Definition, Lemma and Theorems	3	K4(An)	Lecture using Chalk and talk, Lecture using PPT, Problem solving	MCQ, Recall steps, Questioning and Home Assignment
IV	**The partition Function**					
	1.	**Partitions definitions-** Definition, examples and Theorems	3	K4(An)	Lecture with Illustration, Lecture using PPT, Problem solving	Peer teaching, MCQ, Recall steps, Questioning and Home Assignment
	2.	**Ferrers Graphs-** Definition, examples and Theorems	2	K4(An)	Lecture with Illustration, Lecture using PPT, Problem solving	Questioning and Home Assignment
	3.	**Formal power series**, Generating Functions and Euler's identity- Definition, examples and Theorems	3	K4(An)	Lecture with Illustration, Lecture using PPT, Problem solving	Class test, Questioning and Home Assignment

	4.	**Euler's identity** and bounds on p(n)- Lemma and Theorems	4	K4(An), K5(E)	Lecture with Illustration, Lecture using PPT, Problem solving	Peer teaching, MCQ, Recall steps, Questioning and Home Assignment
V	**Public Key Cryptography**					
	1.	**The concepts of Public Key Cryptography -** Definition and examples	3	K4(An)	Lecture with Illustration, Lecture using PPT, Problem solving, Peer teaching.	Peer teaching, MCQ, Recall steps, Seminar Questioning and Home Assignment
	2.	**RSA Cryptosystem with examples**	2	K4(An)	Lecture with Illustration, Lecture using Videos, Problem solving, Peer teaching	Questioning ,Seminar
	3.	**Discrete log cryptosystem** with examples, The Diffie – Hellman key exchange system and assumption with examples	3	K4(An)	Lecture with Illustration, Lecture using PPT, Problem solving, Peer teaching	Suggest idea/concept examples, Seminar
	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	4	K4(An)	Lecture with Illustration, Lecture using PPT, Problem solving, Peer teaching	Evaluation through asking question, Home Assignment, Seminar
	5.	**Basic facts of Elliptic curves**, Elliptic curves over the reals, complexes and rationales, Points of finite order with examples	3	K4(An)	Lecture with Illustration, Lecture using PPT, Problem solving, Peer teaching	Evaluation through short test, Seminar

	6.	Analog of the Diffie-Helman key exchange, Analog of Massey - Omura, Analog of ElGamal, reducing a global modulo p with examples	3	K4(An)	Lecture with Illustration, Lecture using videos, Problem solving, Peer teaching	Recall steps, Seminar

Course Focussing on : Skill Development

Activities: Solving problems in Legendre symbol, Solving problems in different type of forms, Seminar , Online Quiz, Pythagorean triangles through videos.

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

Activities related to Cross Cutting Issues: Nil

Assignment : Problems on Quadratic Residues, Problems on Binary Quadratic forms Problems on Pythagorean Triangle and Elliptic curves

Seminar Topic: The partition Function, Public Key Cryptography

Sample questions

Part A

1. The value of $\left(\frac{7}{13}\right)$ = ----------
2. The form f(x, y) = $x^2 + y^2$ is called ----------
   a) Definite b) indefinite c) positive definite d) positive semi definite
3. The value of 'Ω(12) is ------------
   a)1 b) 3 c) 5 d) None of the above
4. The conjugate of the conjugate partition is the ------------
5. Public-key cryptography is also known as -----------
   a) Asymmetric cryptography b) Symmetric cryptography
   c) Both A and B d) None of the above

Part B

1. State and prove Gaussian Reciprocity law.
2. Let f(x , y) = $ax^2 + bxy + cy^2$ be a binary quadratic form with integral coefficients and discriminant d. If d $\neq$ 0 and d is not a perfect square, then prove that a $\neq$ 0, c $\neq$ 0 and the only solution of the equation f (x , y) = 0 in integers is x = y = 0.
3. For every positive integer n, $\sigma(n) = \prod_{p^{\alpha}//n} \left(\frac{p^{\alpha+1}-1}{p-1}\right)$
4. Derive Euler's identity.
5. Write a short note on authentication.

Part C

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

   Also $\left(\frac{2}{p}\right) = (-1)^{\frac{(p^2-1)}{8}}$.
2. Let n and d be given integers with n $\neq$ 0. Prove that there exists a binary quadratic form of discriminant d that represents n properly iff the congruence $x^2 \equiv d \pmod{4|n|}$ has a solution.
3. State and prove Mobius inversion formula.
4. If n $\geq$ 0, prove that $q^e(n) - q^o(n) = \begin{cases} (-1)^j & \text{if } n = (3j^2 \pm j)/2 \text{ for some } j = 0,1,2,\ldots \\ 0 & \text{otherwise} \end{cases}$
5. Explain the Diffle-Hellman key exchange system.

Head of the Department

Dr.S.Kavitha

Course Instructor

Dr.S.Kavitha