Course Structure (w.e.f. June 2021)
Semester - I

Subject	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core I	21PMAC11	Groups and Rings	6	4	40	60	100
Core II	21PMAC12	Real Analysis	6	4	40	60	100
Core III	21PMAC13	Ordinary differential Equations	6	4	40	60	100
Core IV	21PMAC14	Mathematical Statistics	6	4	40	60	100
Elective I	21PMAE11/ 21PMAE12	A. Combinatorics/ B.Fuzzy Sets	6	4	40	60	100
			30	**20**			

Semester - II

Subject	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core V	21PMAC21	Linear Algebra	6	4	40	60	100
Core VI	21PMAC22	Mathematical Analysis	6	4	40	60	100
Core VII	21PMAC23	Classical Mechanics	6	4	40	60	100
Core VIII	21PMAC24	Calculus of Variations and Integral Equations	4	4	40	60	100
Core IX	21PMAC25	Stochastic Processes	4	4	40	60	100
Elective II	21PMAE21/ 21PMAE22	A. Operations Research/ B. Applied Algebra	4	3	40	60	100
			30	**23+2**			

Semester - III

Subject	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core X	21PMAC31	Topology	6	4	40	60	100
Core XI	21PMAC32	Graph Theory	6	4	40	60	100
Core XII	21PMAC33	Measure Theory	5	4	40	60	100
Core XIII	21PMAC34	Partial Differential Equations	5	4	40	60	100
Core XIV	21PMAC35	Research Methodology	4	4	40	60	100
Elective III	21PMAE31/ 21PMAE32	A. Fluid Mechanics/ B. Wavelet Analysis	4	3	40	60	100
Self Study Course / MOOC/ Internship	21PMSS31 21PMAM31 21PMAI31	Course on Competitive Exams		+2		100	100
			30	**23 + 2**			

Semester - IV

Subject	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core XV	21PMAC41	Complex Analysis	6	4	40	60	100
Core XVI	21PMAC42	Functional Analysis	6	4	40	60	100
Core XVII	21PMAC43	Number Theory and Cryptography	5	4	40	60	100
Elective IV	21PMAE41/ 21PMAE42	A. Differential Geometry/ B. Projective Geometry	5	4	40	60	100
Project	21PMAP41	Project	8	8	40	60	100
			30	**24**			
Total			**120**	**90+2+2**			

LESSON PLAN

ObjectiveOrientedLearningProcessRBT

Programme	M.Sc.Mathematics
Semester	I
Subject Title	Core I – Groups and Rings
Code	21PMAC11
Hours	6
Total Hours	90
Credits	4
Max Marks	100
Unit & Title	Unit:I – Cayley Theorem
Name of the Faculty	Ms.J.Jenit Ajitha
T-Ltools	**Lecture method, PPT, Group Discussion**

PrerequisiteKnowledge:

- **Knowledge** of Basic concepts of group theory, understanding of permutations and symmetric groups and fundamental operations in algebra.

.**Micro-planning**

1. **Topic for Learning through Evocation:**

   Cayley's Theorem

2. **Topic Introduction:**

   Cayley's Theorem states that every group is isomorphic to a subgroup of the symmetric group acting on itself. This fundamental theorem establishes that any abstract group can be represented concretely as a group of permutations.

   2.1 General Objective:

   To understand and apply Cayley's Theorem in abstract algebra and demonstrate how every group can be embedded into a symmetric group.

   2.2 Specific Objectives:

   Enable the students to:

   1. Define and explain Cayley's Theorem.
   2. Prove the theorem using bijective mapping.
   3. Illustrate the theorem with examples.
   4. Apply the theorem in different algebraic contexts.

   2.3Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1	1				
B. Conceptual Knowledge		3	3			
C. Procedural Knowledge			2,4	2,4	4	
D. Meta-Cognitive Knowledge						

2.4 Keywords: Group Theory, Symmetric Group, Isomorphism, Permutations, Bijective Mapping

2.5 Key diagrams :

- ***Cayley Graph of a non abelian group***

```
e   --a-->  a
|         / |
b       /   |
↓     /     ↓
b <--a--   ab
```

- **Bijective Mapping Diagram between a group and its permutation group**

```
G                   S3
o  e                o  ()
|                   |
o  g1     ⇔         o  (12)
|                   |
o  g2               o  (123)
```

- **Multiplication Table**

$\cdot$	e	a	a^2
e	e	a	a^2
a	a	a^2	e
a^2	a^2	e	a

3. Power Point Presentation :

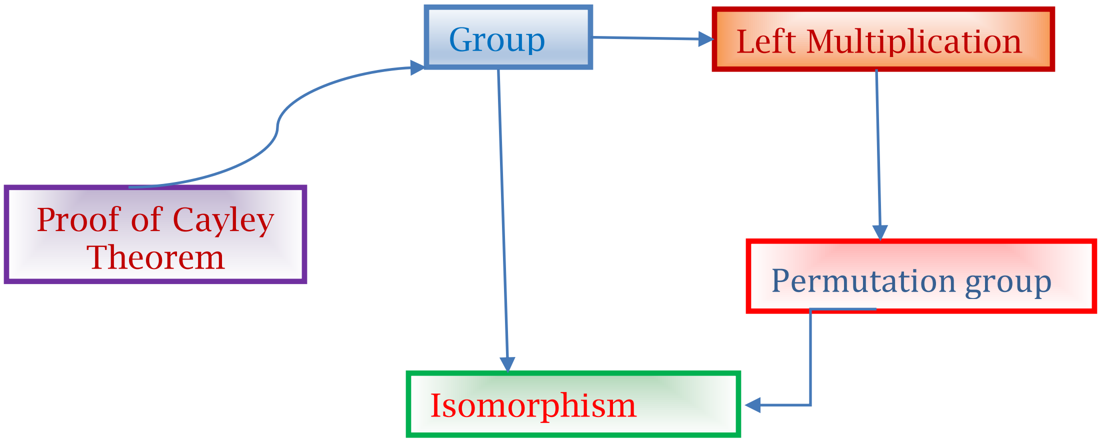
https://gamma.app/docs/Cayleys-Theorem-Every-Group-is-a-Subgroup-of-a-Permutation-Group-6k4hxst5dfb6zuq

4. Group Discussion:

a) How does Cayley's Theorem help in understanding abstract groups?

b) Examples demonstrating the application of the theorem.

5. Mind Map



6. Summary:

Cayley's Theorem establishes that any group can be seen as a permutation group. This allows us to study abstract groups through concrete representations, reinforcing the foundational ideas of group theory.

7. Assessment:

- Prove Cayley's Theorem for a group of order 5.
- Give an example of an abstract group and find its corresponding symmetric group representation.
- Explain why Cayley's Theorem is significant in group theory

8. FAQs:

1. **Why is Cayley's Theorem important?**
    - It provides a bridge between abstract group theory and concrete permutation representations.
2. **Does Cayley's Theorem hold for infinite groups?**
    - Yes, it applies to both finite and infinite groups.
3. **What is an isomorphism in group theory?**
    - It is a one-to-one correspondence that preserves the group operation.

9. References:

- Joseph A. Gallian, *Contemporary Abstract Algebra*
- I.N. Herstein, *Topics in Algebra*
- Dummit & Foote, *Abstract Algebra*

Verified By Subject Expert

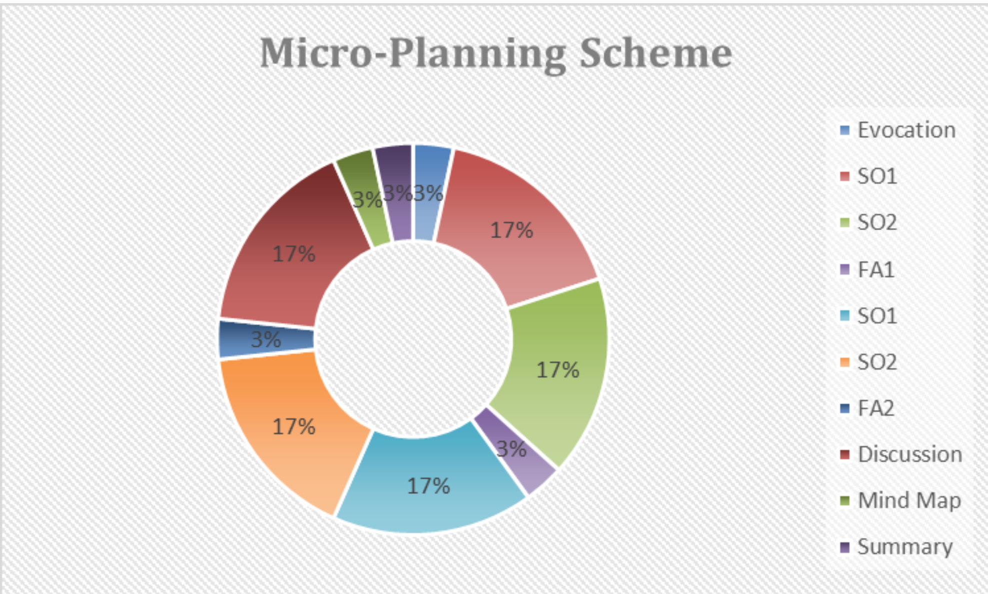
Approved By HOD

Lesson Plan

Programme	M.Sc. Mathematics
Semester	I
Course Title	Real Analysis
Code	21PMAC12
Hours	6
Total Hours	90
Credits	4
Max Marks	50
Unit & Title	Unit V - Uniformly Continuous
Name of the Faculty	Dr. C. Reena
T-L tools	Mind Maps, PowerPoint, Group Discussion

Pre-requisite Knowledge: Basic understanding of limits and continuity, concept of metric spaces and functions

Micro- Planning : 60 minutes



Evocation	: 2 min
SO1	: 10 min
SO2	: 10 min
FA1	: 2 min
SO1	: 10 min
SO2	: 10 min
FA2	: 2 min
Discussion	: 10 min
Mind Map	: 2 min
Summary	: 2 min

1. **Topics for learning through Evocation:**
   Initiate discussion on the difference between pointwise continuity and uniform continuity.
2. **Topic Introduction:**

2.1: General Objective:

- To understand the concept of uniform continuity and how it differs from ordinary continuity.
- To learn about the mathematical characterization of uniformly continuous functions.

2.2: Specific Outcomes:

- Define uniform continuity and its mathematical formulation.
- Identify uniformly continuous functions using the definition and examples.
- Apply uniform continuity in proving fundamental theorems in analysis.

First Phase:

SO1 (10 minutes): Explain the formal definition of uniform continuity and illustrate it with examples.

SO2 (10 minutes): Discuss the relationship between uniform continuity and pointwise continuity.

Second Phase:

SO1 (10 minutes): Explain the nature of uniform continuous in compact metric space.

SO2 (10 minutes): Solve problems demonstrating how to test for uniform continuity in different contexts.

Mind Map (2 minutes):

Create a mind map illustrating the relationship between different kinds of continuity

Summary (2 minutes):

Summarize the key takeaways of uniform continuity, emphasizing its role in mathematical analysis.

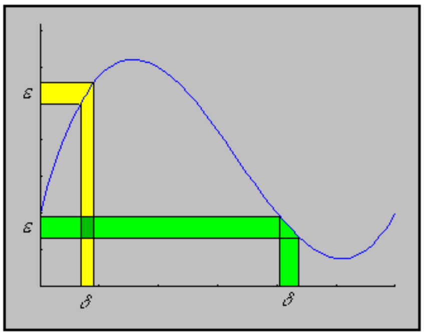
2.3: Taxonomy of objectives:

Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1					
B. Conceptual Knowledge		2				
C. Procedural Knowledge			3	3		
D. Meta-Cognitive Knowledge						

2.4: Key words:

Continuity, Pointwise Continuity and Uniform Continuity

2.5: Key Diagram [if any]



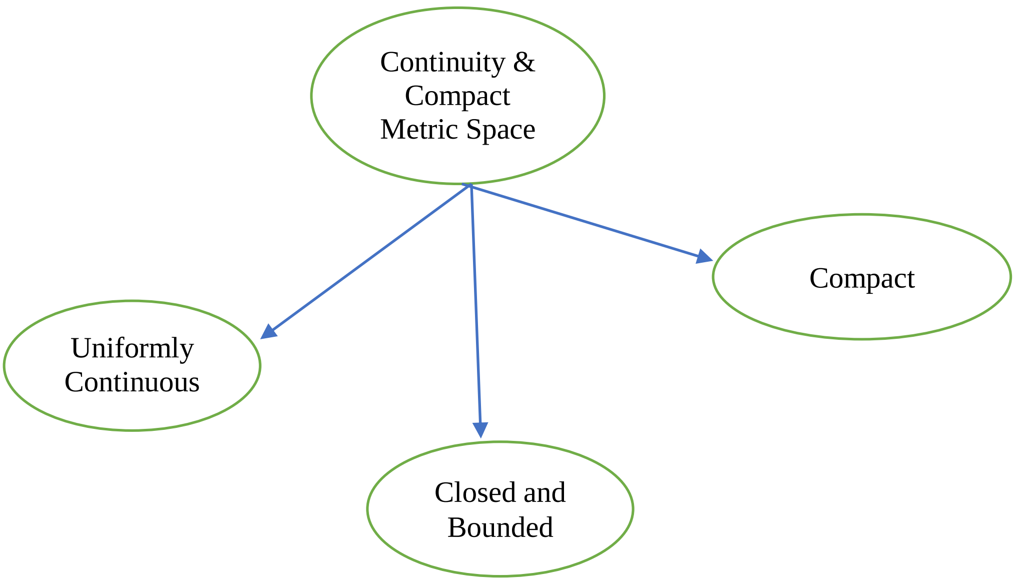
PowerPoint Presentation

https://gamma.app/docs/Untitled-zdofaf75b5pdqbm

3. Discussion:

Students are encouraged to discuss the importance of uniform continuity in real-world applications and further mathematical research.

4. Mind Map



5. Summary

Uniform continuity ensures that function behavior is controlled across an entire domain rather than just at individual points. This property is crucial in compact metric spaces and has significant applications in functional analysis and differential equations.

6. Assessment through questions/analogy/new ideas:

- Formative Assessment 1 (FA1) (2 minutes) Ask students to provide an example of a function that is continuous but not uniformly continuous.
- Formative Assessment 2 (FA2) (2 minutes) Quick review of theorems based on uniform continuity.

7. FAQ's: MCQ's/ Descriptive Questions:

1. What is the formal definition of uniform continuity?

2. How does uniform continuity differ from pointwise continuity?

8. References:

- Rudin, W. Principles of Mathematical Analysis. McGraw-Hill.
- Apostol, T. M. Mathematical Analysis. Addison-Wesley.

9. Verified by Subject Expert:

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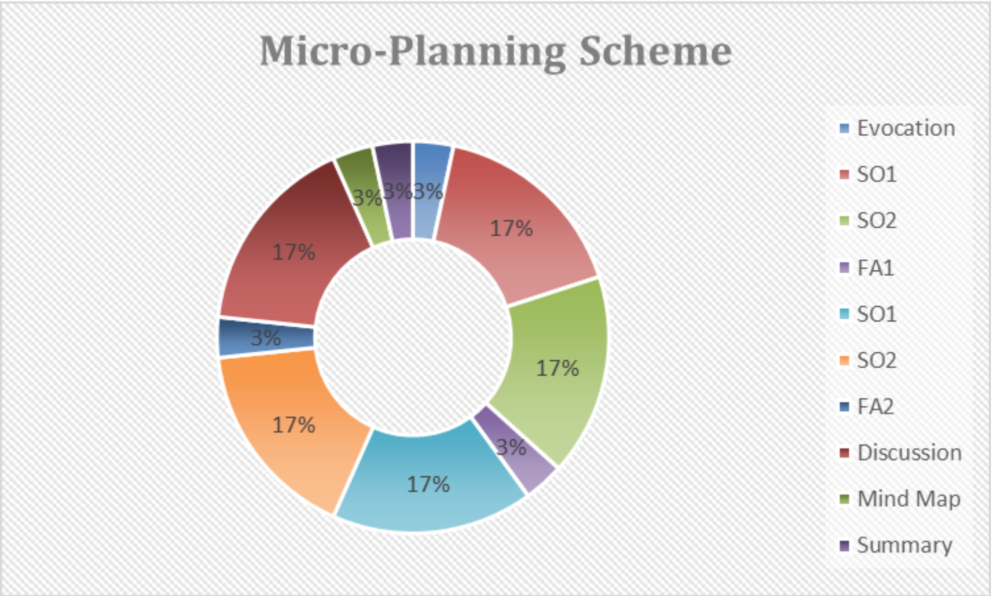
Course In – charge **Approved by HoD**

Lesson Plan

Programme	M.Sc. Mathematics
Semester	I
Course Title	Ordinary Differential Equations
Code	21PMAC13
Hours	6
Total Hours	90
Credits	4
Max Marks	50
Unit & Title	Unit III - Singular Points
Name of the Faculty	Dr. R. Maria Irudhaya Aspin Chitra
T-L tools	Mind Maps, PowerPoint, Group Discussion

Pre-requisite Knowledge: Basic understanding of differential equations, power series solutions, and fundamental calculus concepts.

Micro- Planning : 60 minutes



Evocation	: 2 min
SO1	: 10 min
SO2	: 10 min
FA1	: 2 min
SO1	: 10 min
SO2	: 10 min
FA2	: 2 min
Discussion	: 10 min
Mind Map	: 2 min
Summary	: 2 min

1. **Topics for learning through Evocation:**
   - Introduction to singular points in differential equations.
   - Types of singular points: regular and irregular.
   - Importance of singular points in solving differential equations.

2. **Topic Introduction:**

2.1: General Objective:

- To understand the concept of singular points in differential equations and their classification.
- To explore techniques for solving differential equations with singular points.

2.2: Specific Outcomes:

- Define singular points and differentiate regular and irregular singular points.
- Illustrate examples and counterexamples of singular points.
- Analyze the Frobenius method for solving differential equations with singular points.

First Phase:

SO1 (10 minutes): Explain the literal meaning of singular points in the context of differential equations.

SO2 (10 minutes): Introduce examples illustrating regular and irregular singular points.

Second Phase:

SO1 (10 minutes): Analyze the method of solving differential equations using Frobenius series.

SO2 (10 minutes): Explore other applications and techniques related to singular points.

Mind Map (2 minutes)

A visual representation of different types of singular points and their implications.

Summary (2 minutes)

Recap key concepts, including how singular points impact the solvability of differential equations.

2.3: Taxonomy of objectives:

Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge		1	1			
B. Conceptual Knowledge			2	2	1	
C. Procedural Knowledge		2			2	
D. Meta-Cognitive Knowledge			1	2		

2.4: Key words:

Singular Points, Ordinary Points, Regular Singular Points and Irregular Singular Points

2.5:

PowerPoint Presentation

https://gamma.app/docs/Differential-Equations-tp97i8v6f7kqn2x

3. Discussion:

Students will discuss the necessity of singular point classification in solving differential equations.

4. Mind Map

Singular Points A singular point of a differential equation is a point where the coefficients of the equation become infinite or exhibit irregular behavior, meaning they are not analytic.

Regular Singular Points Singular points where the behavior of the solutions can be understood and analyzed.

Irregular Singular Points Singular points where the solutions exhibit more complex behavior and are often difficult to find analytically.

5. **Summary**

Singular points play a crucial role in understanding the behavior of solutions to differential equations, making them essential in various scientific and engineering applications.

6. **Assessment through questions/analogy/new ideas:**

- Compare ordinary points and singular points through an analogy.
- Provide examples of differential equations and ask students to classify their singular points.

7. **FAQ's: MCQ's/ Descriptive Questions:**

1. Define singular points and differentiate between regular and irregular singular points.

2. Explain the significance of the Frobenius method in solving differential equations.

8. **References:**

- E. Kreyszig, *Advanced Engineering Mathematics*, Wiley.
- G.F. Simmons, *Differential Equations with Applications and Historical Notes*, McGraw-Hill.
- R. Bronson, *Schaum's Outline of Differential Equations*, McGraw-Hill.

9. **Verified by Subject Expert:**

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Course In – charge **Approved by HoD**

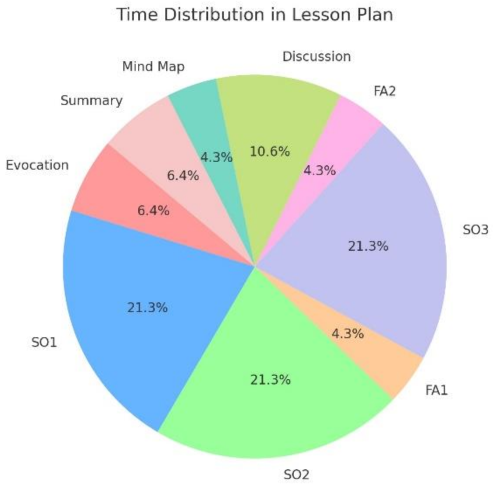
Lesson Plan

Programme	M.Sc. Mathematics
Semester	I
Course Title	Mathematical Statistics
Course Code	21PMAC14
Hours	6
Total Hours	90
Credits	4
Max Marks	50
Unit & Title	Unit II – Some Special Distribution
Name of the Faculty	Dr.P.Anbarasi Rodrigo
T-L tools	Mind Maps, PowerPoint, Group Discussion, Think-Pair-Share

Pre-requisite Knowledge:

- Basic understanding of probability theory
- Concept of random variables and probability mass functions

Micro-Planning: 60 minutes



1. Topics for Learning through Evocation

- Ask students if they have ever flipped a coin multiple times and observed the number of heads they get.
- Introduce the idea of multiple independent trials and their outcomes.

2. Topic Introduction

2.1 General Objective:

- To introduce the concept of binomial distribution as a discrete probability distribution.
- To understand its characteristics, probability mass function, and real-world applications.

2.2 Specific Outcomes:

- **SO1:** Define binomial distribution and its probability mass function.
- **SO2:** Derive mean, variance, and standard deviation of the binomial distribution.

First Phase

SO1 (10 minutes)

- Define **binomial distribution** as a distribution of the number of successes in nn independent Bernoulli trials.
- Present the **probability density function (PDF):** $f(x) = nC_x p^x (1-p)^x$

SO2 (10 minutes)

- Discuss properties of binomial distribution:
    - **Mean:** $E(X) = np$
    - **Variance:** $Var(X) = np(1-p)$
- Show graphical representations of binomial distributions for different values of n and p.

FA1 (Formative Assessment 1 – 2 minutes)

- Ask students to calculate the probability of getting exactly 3 heads in 5 tosses of a fair coin.

Second Phase

SO1 (10 minutes)

- Introduce the concept of binomial approximation to normal distribution when n is large.

SO2 (10 minutes)

- Discuss real-life applications:
    - Quality control in manufacturing
    - Probability of passing a test based on guessing
    - Success rates in medical trials

FA2 (Formative Assessment 2 – 2 minutes)

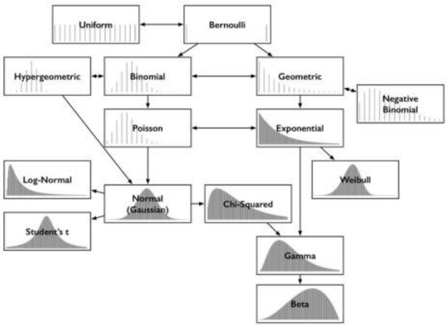
- Ask students to compute the expected value and variance for a given binomial distribution problem.

3. Discussion (10 minutes)

- Engage students in a conversation on how binomial distribution applies in real-world situations.
- Encourage students to discuss scenarios where binomial distribution might not be appropriate.

4. **Mind Map (2 minutes)**

- Create a mind map connecting **binomial distribution and distribution.**



5. Summary (2 minutes)

- Recap the binomial distribution formula and its properties.
- Emphasize its importance in probability modeling and real-world applications.

6. Taxonomy of Objectives

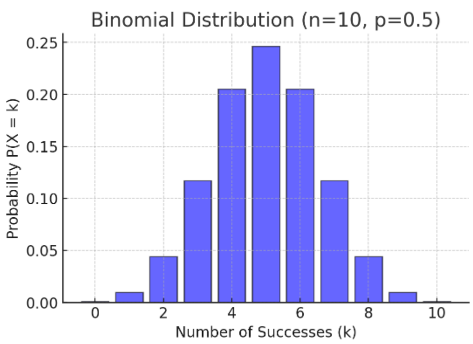
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1					
B. Conceptual Knowledge		1				
C. Procedural Knowledge			1,2	2	2	
D. Meta-Cognitive Knowledge				1	2	

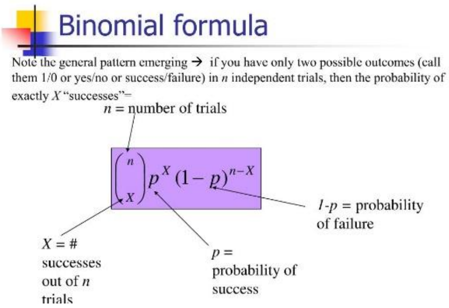
7. Key Words

- Binomial distribution
- Probability density function
- Expected value
- Variance
- Bernoulli trial

8. Key Diagrams

- Graphs of binomial distributions for different n and p.





Powerpoint Persentation: https://in.docworkspace.com/d/sIEGA0OVSjfervQY

9. Assessment through Questions/Analogy/New Ideas

- Provide a real-world problem and ask students to determine whether it fits a binomial model.
- Compare the binomial distribution with the Poisson distribution and discuss when to use each.

10. FAQ's (MCQ's/Descriptive Questions)

1. **Multiple Choice Questions:**
    - What is the expected value of a binomial random variable with parameters n and p?
    - How does the variance of a binomial distribution change with increasing pp?
    - In a binomial experiment, what happens when p=0.5?
2. **Descriptive Questions:**
    - Derive the mean and variance of a binomial distribution.
    - Give an example where binomial distribution is applicable and justify why.
    - Compare and contrast binomial and Poisson distributions.

11. References

- Robert V, Hogg and Allen T. Craig, Introduction to Mathematical Statistic, Pearson Education Asia, Fifth edition, 2004.
- Feller, W. *An Introduction to Probability Theory and Its Applications*, Wiley, 1968.
- Casella, G., & Berger, R. *Statistical Inference*, Duxbury, 2002.

12. Verified by Subject Expert:

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LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc.Mathematics
Semester	I
Subject Title	Elective – Combinatorics
Code	21PMAE11
Hours	6
Total Hours	90
Credits	4
Max Marks	100
Unit & Title	Unit III – Distribution of Distinct and Non-Distinct Objects
Name of the Faculty	Ms.I.Anbu Rajammal
T-Ltools	**Lecture method, PPT, Group Discussion**

PrerequisiteKnowledge:

- Basic understanding of permutations, combinations, and counting principles.

Micro-planning

1. **Topic for Learning through Evocation:**
   Combinatorics.

2. **Topic Introduction:**

   Introduction to distribution problems using real-life examples (e.g., allocating resources, distributing gifts, seating arrangements). The importance of understanding distinct and non-distinct distributions in combinatorics.

2.1 General Objective:
To understand the principles behind distributing distinct and non-distinct objects into distinct boxes and their real-world applications.

2.2 Specific Outcomes:

SO1: Define and differentiate between distinct and non-distinct object distributions.

SO2: Identify various distribution methods such as ordered, unordered, with and without restrictions.

SO3: Apply combinatorial techniques to solve distribution problems.

2.3 Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1	1,2				
B. Conceptual Knowledge		2				
C. Procedural Knowledge			3		3,4	
D. Meta-Cognitive Knowledge						4

2.4 Keywords: Functionals, Euler-Lagrange Equation, Extremals, Maxima and Minima, Optimization Problems.

2.5 Key diagram:

- Flowchart differentiating distinct and non-distinct distributions.
- Representation of stars and bars method.
- Visual depiction of constrained and unconstrained distribution problems

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc.Mathematics
Semester	II
Subject Title	Core –Linear Algebra
Code	21PMAC21
Hours	6
Total Hours	90
Credits	4
Max Marks	100
Unit & Title	Unit:II – Gram Schmidt Process
Name of the Faculty	Ms.J.JenitAjitha
T-Ltools	**Lecture method, PPT, Group Discussion**

PrerequisiteKnowledge:

- **Knowledge**of Basics of vector spaces
- Concept of inner products and norms
- Understanding of linear independence and orthogonality**.**

.**Micro-planning**

1. **Topic for Learning through Evocation:**
   Gram-Schmidt Process for Inner Product Spaces

2. **Topic Introduction:**

   The Gram-Schmidt process transforms a set of linearly independent vectors into an orthonormal basis. It plays a fundamental role in linear algebra, numerical analysis, and quantum mechanics..

   2.1 General Objective:

   To understand the Gram-Schmidt process and how it is used to construct orthonormal bases in inner product spaces..

   2.2 Specific Objectives:

   Enable the students to:

   1. Define inner product spaces and their properties.
   2. Explain the Gram-Schmidt orthogonalization process.
   3. Apply the Gram-Schmidt process to obtain orthonormal bases.
   4. Explore real-world applications in numerical analysis and quantum mechanics.

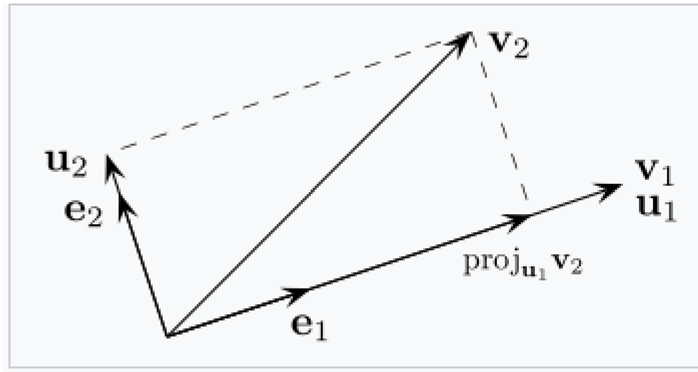
   2.3Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1	1				
B. Conceptual Knowledge		2		2		
C. Procedural Knowledge			3		3	
D. Meta-Cognitive Knowledge						4

2.4 Keywords: Inner Product Spaces, Orthogonality, Gram-Schmidt Process, Orthonormal Basis, Linear Independence.

2.5 Key diagrams :

- ***First Two steps of Gram Schmidt Process***



3. Power Point Presentation :

https://gamma.app/docs/Gram-Schmidt-Process-Orthogonalization-Explained-260d7z86b2gqnqi

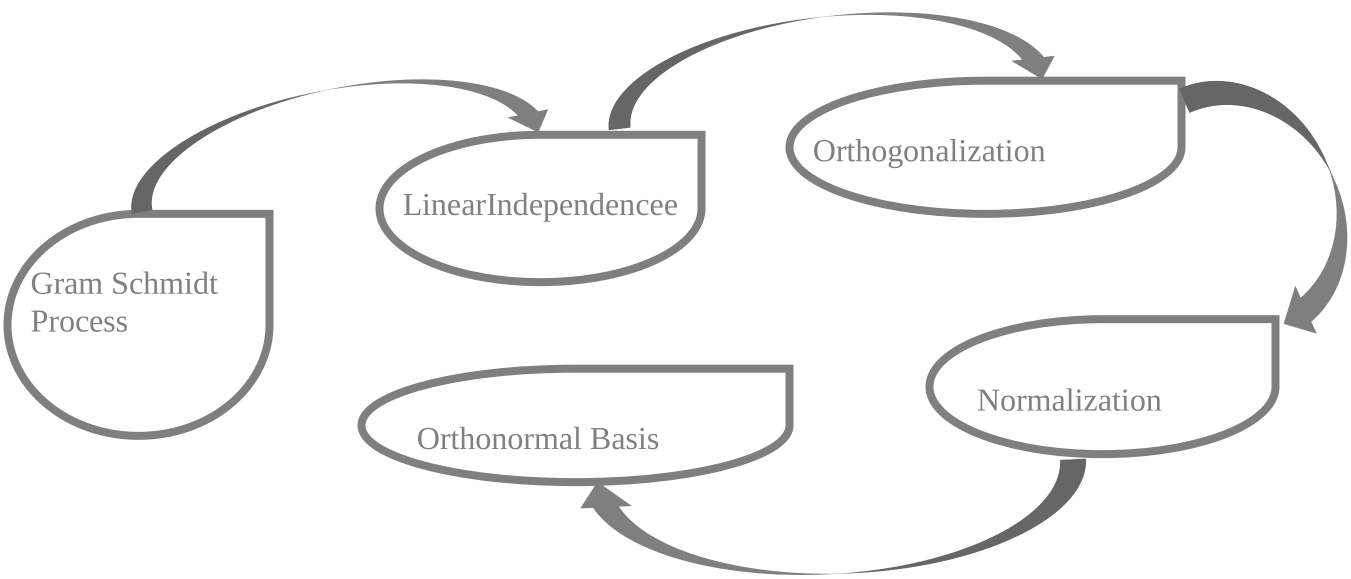
4. Group Discussion:

a) Define the problem – Given a set of vectors, convert them into an orthogonal (or orthonormal) set.

b)Normalize the vectors to obtain an orthonormal set.

c) Explain the projection formula.

5. Mind Map



6. Summary:

The Gram-Schmidt process transforms a set of linearly independent vectors into an orthonormal basis. It is widely used in matrix factorization and numerical stability in computations.

7. Assessment:

- **Solve problems applying Gram-Schmidt on 2D and 3D vectors.**
- **Conceptual questions on the importance of orthogonalization.**
- **Discussion on real-life applications**?

8. FAQs:

1. Why do we need orthonormal bases?
They simplify computations and maintain numerical stability in algorithms.

2. What happens if the vectors are already orthogonal?
The process will still work but won't modify the vectors**.**

3. Can we apply this process to dependent vectors?
No, the process requires linearly independent vectors**.**

9. References:

Standard Linear Algebra textbooks and online resources

Verified By Subject Expert

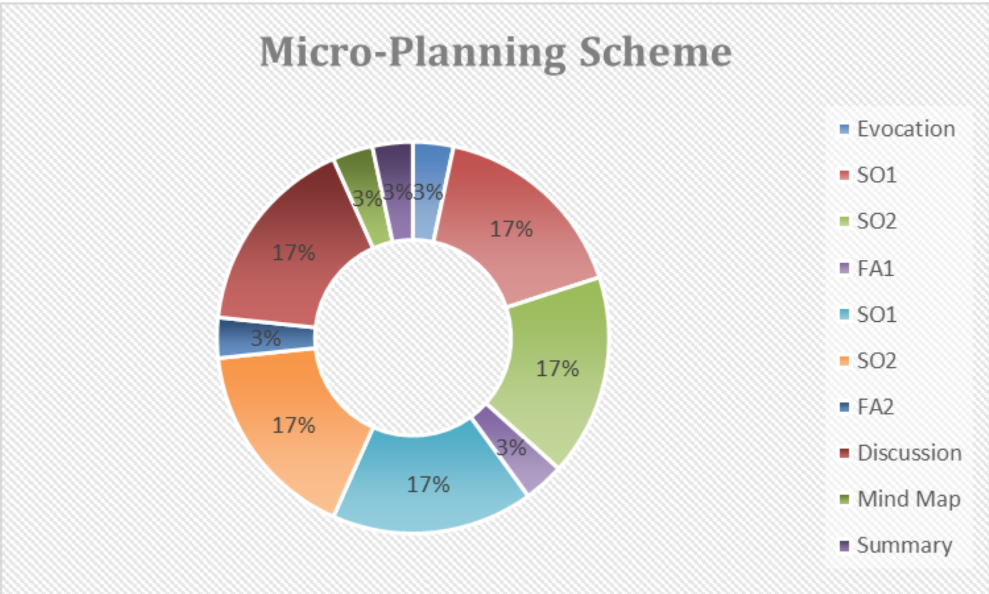
Approved By HOD

Lesson Plan

Programme	M.Sc. Mathematics
Semester	II
Course Title	Mathematical Analysis
Code	21PMAC22
Hours	6
Total Hours	90
Credits	4
Max Marks	50
Unit & Title	Unit III - Uniform Convergence and Differentiation
Name of the Faculty	Dr. C. Reena
T-L tools	Mind Maps, PowerPoint, Group Discussion

Pre-requisite Knowledge: Basic understanding of sequences and series of functions, pointwise convergence, and fundamental calculus concepts.

Micro- Planning : 60 minutes



Evocation : 2 min
SO1 : 10 min
SO2 : 10 min
FA1 : 2 min
SO1 : 10 min
SO2 : 10 min
FA2 : 2 min
Discussion : 10 min
Mind Map : 2 min
Summary : 2 min

1. **Topics for learning through Evocation:**

- Introduction to different types of function convergence.
- The need for uniform convergence in analysis.

2. **Topic Introduction:**

2.1: General Objective:

- To understand the concept of uniform convergence and its role in ensuring the interchangeability of limits, integration, and differentiation.
- To apply uniform convergence in real-world scenarios involving continuous functions and differentiable functions.

2.2: Specific Outcomes:

1. Define uniform convergence and differentiate it from pointwise convergence.
2. Illustrate examples and counter examples to demonstrate uniform convergence.
3. Analyze the implications of uniform convergence on integration and differentiation.

First Phase:

SO1 (10 minutes): Explain the literal meaning of uniform convergence.

SO2 (10 minutes): Introduce examples illustrating uniform and non-uniform convergence.

Second Phase:

SO1 (10 minutes): Analyze the impact of uniform convergence on differentiation and integration.

SO2 (10 minutes): Explore other applications and important theorems related to uniform convergence.

Mind Map (2 minutes)

A visual representation of definition of uniform convergence, difference between pointwise convergence and uniform convergence and its applications.

Summary (2 minutes)

Recap key concepts, including how uniform convergence ensures smooth transitions between function operations.

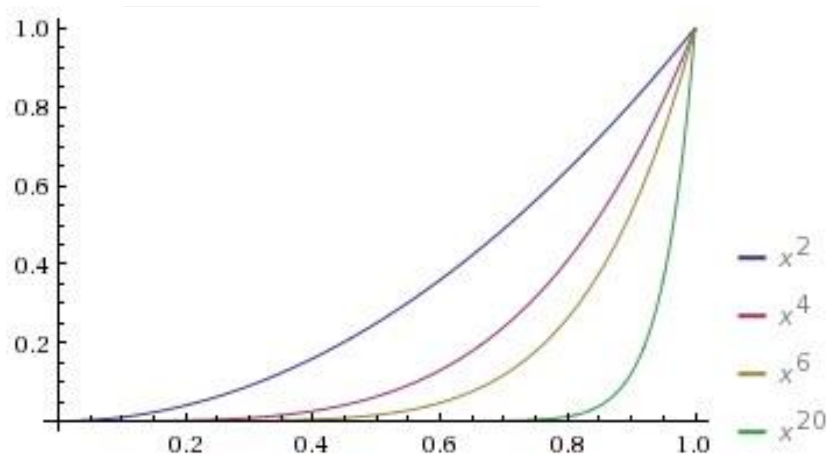
2.3: Taxonomy of objectives:

Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1					
B. Conceptual Knowledge		2		1, 2,3		
C. Procedural Knowledge						
D. Meta-Cognitive Knowledge						

2.4: Key words:

Uniform Convergence, Pointwise Convergence, Weierstrass M-Test

2.5: Key Diagram [if any]



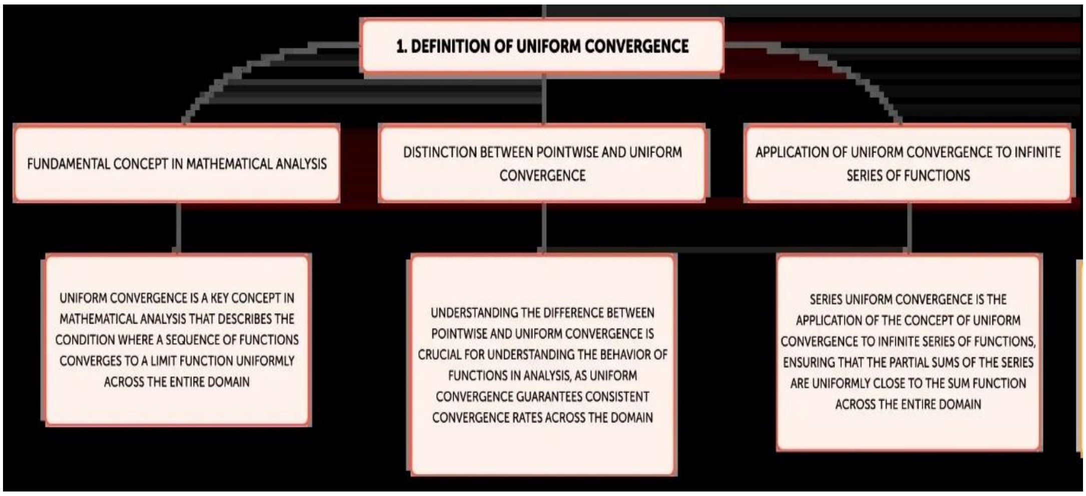
PowerPoint Presentation

https://gamma.app/docs/Untitled-wesxeel0toml350

3. Discussion:

Students will discuss the necessity of uniform convergence in practical applications such as Fourier series, numerical methods, and approximation theory

4. Mind Map



5. Summary

Uniform convergence ensures function sequences behave well under limit operations, making it crucial in analysis.

6. Assessment through questions/analogy/new ideas:

- Formative Assessment 1 (FA1) (2 minutes) Compare pointwise and uniform convergence through an analogy.
- Formative Assessment 2 (FA2) (2 minutes) Provide examples of sequences of functions and ask students to determine if they converge uniformly.

7. FAQ's: MCQ's/ Descriptive Questions:

1. Define uniform convergence and differentiate it from pointwise convergence.
2. State and explain the Weierstrass M-Test.
3. Why is uniform convergence important in differentiation?
4. Give an example of a function sequence that converges pointwise but not uniformly.

8. References:

- Rudin, W. Principles of Mathematical Analysis. McGraw-Hill.
- Apostol, T. M. Mathematical Analysis. Addison-Wesley.
- R. Bartle, *The Elements of Real Analysis*, John Wiley & Sons.

9. Verified by Subject Expert:

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Research Department of Mathematics
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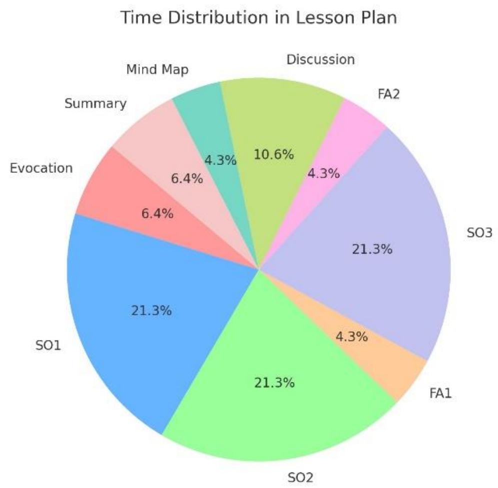
Course In – charge **Approved by HoD**

Lesson Plan

Programme	M.Sc. Mathematics
Semester	II
Course Title	Classical Mechanics
Course Code	21PMAC23
Hours	6
Total Hours	90
Credits	4
Max Marks	50
Unit & Title	Unit III – Equations of a Motion of a Rigid Body
Name of the Faculty	Dr.P.Anbarasi Rodrigo
T-L tools	Mind Maps, PowerPoint, Group Discussion, 3D Visualization

Pre-requisite Knowledge: Basic understanding of rotational motion, coordinate systems, and vector mathematics.

Micro-Planning: 60 minutes



1. Topics for learning through Evocation:

Introduce the concept of rotational motion in three dimensions.

2. Topic Introduction:

2.1: General Objective:

- To understand the concept of Eulerian Angles and their application in describing rotational motion.
- To apply Eulerian Angles in real-world contexts like robotics and aerospace engineering.

2.2 : Specific Outcomes:

- SO1: Define Eulerian Angles and their standard order of application.
- SO2: Illustrate the physical meaning of the three angles: Precession, Nutation, and Spin.
- SO3: Apply Eulerian Angles to solve orientation problems in mechanics.

First Phase:

- SO1 (10 minutes): Explain what Eulerian Angles are and their standard sequences (ZYZ, XYZ, etc.).
- SO2 (10 minutes): Discuss their usage in describing orientations and rotations in mechanics.

Second Phase:

- SO3 (10 minutes): Solve example problems involving the application of Eulerian Angles in rotating system.

Mind Map (2 minutes):
Create a mind map showing the breakdown of Eulerian Angles: Precession (ψ), Nutation (θ), Spin (φ), and their respective rotations about the principal axes.

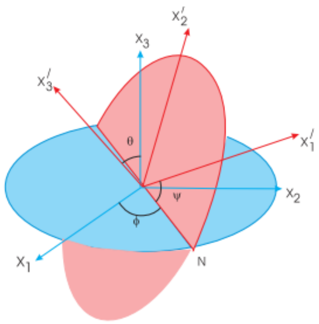
Summary (3 minutes):
Summarize how Eulerian Angles provide a powerful way to describe and compute complex rotational motions, reinforcing their importance in mechanical systems and engineering applications.

2.3 : Taxonomy of objectives:

Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1	1				
B. Conceptual Knowledge		1,2				
C. Procedural Knowledge			1,2			
D. Meta-Cognitive Knowledge			3	1,3	3	

2.4 : Key words:
Eulerian Angles, Precession, Nutation, Spin, Rotational Motion

2.5 : Key Diagrams:



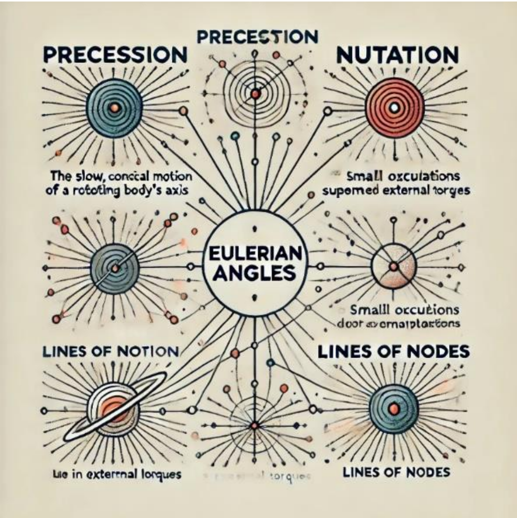
- Pie chart showing time allocation in the lesson plan.
- Mind map of Eulerian Angles and their rotations.

- Powerpoint Presentation: https://gamma.app/docs/h6ncirxh9szoqw2?following_id=jac03q1dr6c2gjm&follow_on_start=true

3. Discussion:

Students will discuss how different Eulerian Angles sequences can be used in various engineering applications

4. Mind Map



5. Summary

Eulerian Angles are a fundamental tool in mechanics for describing the orientation of rigid bodies. They are particularly useful in applications requiring precise control and understanding of rotations, like satellite orientation.

6. Assessment

- Formative Assessment 1 (FA1) (2 minutes): Students describe the three Eulerian Angles in their own words.
- Formative Assessment 2 (FA2) (2 minutes): Quick quiz on the sequence of rotations in a given problem.

7. FAQ's : MSQ's/ Descriptive questions:

1. What are Eulerian Angles? State their applications in engineering.
2. Explain the differences between Precession, Nutation, and Spin.

8. References:

- C.R.Mondal. *Classical Mechanics*. Prentice Hall of India, 2007.
- H. Goldstein, *Classical Mechanics*, (2nd Edition) 2000, Narosa Publishing House, New Delhi

9. Verfied by Subject Expert:

Course In – charge **Approved by HoD**

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc.Mathematics
Semester	II
Subject Title	Core IV– Calculus of Variations and Integral Equations
Code	21PMAC24
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit:I– Calculus of Variations and Applications: Maxima and Minima
Name of the Faculty	Ms.J.JenitAjitha
T-Ltools	**Lecture method, PPT, Group Discussion**

PrerequisiteKnowledge:

- **Knowledge** of Basics of **Differential and Integral Calculus**
- **Concept of** Functions and Functionals
- **Fundamental Maxima and Minima principles in single-variable calculus.**

Micro-planning

1. **Topic for Learning through Evocation:**
   Calculus of Variations and Its Application to Maxima and Minima.

2. **Topic Introduction:**
   Calculus of Variations extends the concept of maxima and minima to functionals rather than just functions. It plays a crucial role in physics, engineering, and optimization problems. The Euler-Lagrange equation provides a way to determine extrema of functionals.

2.1 General Objective:
To understand calculus of variations and its application to finding maxima and minima of functionals.

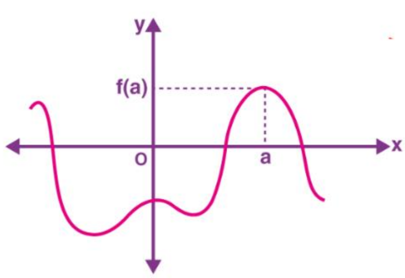
2.2 Specific Objectives:
Enable the students to:
1. Define Calculus of Variations and its significance.
2. Learn about functionals and their extrema.
3. Derive and apply the Euler-Lagrange equation.
4. Solve real-world optimization problems using calculus of variations.

2.3 Taxonomy of objectives:

TaxonomyofObjectives						
Knowledge Dimension	**TheCognitiveProcessDimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1	1,2				
B. Conceptual Knowledge		2				
C. Procedural Knowledge			3		3,4	
D. Meta-Cognitive Knowledge						4

2.4 Keywords: Functionals, Euler-Lagrange Equation, Extremals, Maxima and Minima, Optimization Problems.

2.5 Key diagram:
- **Graph of a function**

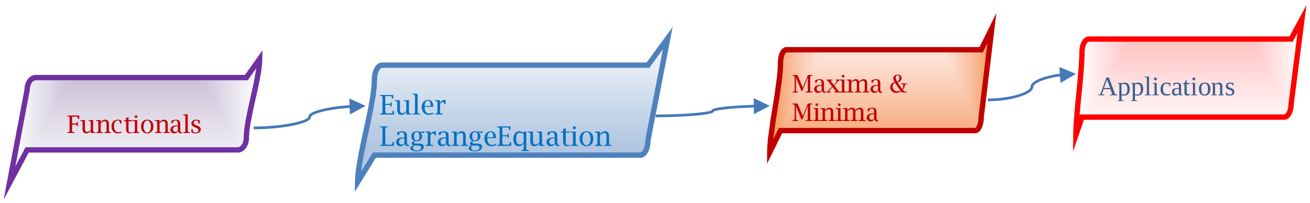


3. Power Point Presentation :
https://gamma.app/docs/Calculus-of-Variations-Finding-Maxima-and-Minima-kcv2y0k44reygrx

4. Group Discussion:

a) Introduction to Calculus of Variations.
b)Understanding Functionals and Their Extrema
c) Euler-Lagrange Equation and Maxima-Minima.

5. Mind Map



6. Summary:

Calculus of Variations generalizes maxima and minima for functionals.The Euler-Lagrange equation gives necessary conditions for extrema. Applications include physics, engineering, and economics.

7. Assessment:

- **Short answer questions:** Define functional and Euler-Lagrange equation**.**
- **Problem-solving:** Find extremals for given functionals**.**
- **Application-based:** Use calculus of variations to solve real-world scenarios**?**

8. FAQs:

1. What is a functional?
A functional assigns a real number to an entire function.
2. How is calculus of variations different from regular calculus?
It deals with functionals instead of functions.
3. What is the Euler-Lagrange equation?
A fundamental equation to find functionals' extrema**.**
4. What are real-world applications of calculus of variations?
Physics (Least Action), Engineering (Optimization), Economics (Cost Minimization)**.**

9. References:

Classical Mechanics Textbooks
Optimization Theory Research Papers

Verified By Subject Expert

Approved By HOD

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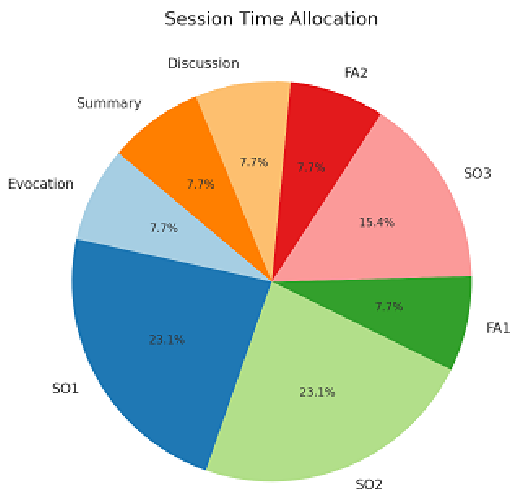
Programme	M.Sc. Mathematics
Semester	II
Course Title	Stochastic Processes
Course Code	21PMAC25
Hours	4
Total Hours	60
Credits	4
Max Marks	50
Unit & Title	Unit III – Classification of states and chains
Name of the Faculty	Dr. R. Maria Irudhaya Aspin Chitra
T-L tools	Mind Maps, PowerPoint, Group Discussion, 3D Visualization

Pre-requisite Knowledge:

Basic understanding of probability theory, Markov processes, and transition matrices.

Micro-Planning: 60 minutes



Phase	Time (Minutes)
Evocation	5 min
SO1	15 min
SO2	15 min
FA1	5 min
SO3	10 min
FA2	5 min
Discussion	5 min
Summary	5 min

1. Topics for Learning through Evocation

- Introduce Markov chains with real-world applications such as population dynamics and queuing theory.
- Discuss state classifications in a simple example like a board game or a customer service system.

2. Topic Introduction

2.1 General Objective:

To understand the classification of states in Markov chains and their role in stochastic processes.

2.2 Specific Outcomes:

- **SO1:** Define Markov chains and describe their basic properties.
- **SO2:** Classify states based on recurrence, transience, and periodicity.
- **SO3:** Analyze different types of Markov chains and their long-term behavior.

First Phase:

SO1:

- Define Markov chains and transition probabilities.
- Explain the concept of state space and transition matrices.
- Present examples in discrete-time Markov processes.

SO2:

- Define and explain recurrent and transient states.
- Discuss periodic and aperiodic states with examples.
- Provide applications in practical scenarios such as stock market trends.

Formative Assessment 1 (FA1):

- Quick quiz: Identify transient and recurrent states in given Markov chains.

Second Phase:

SO3:

- Explain absorbing states and ergodic Markov chains.
- Analyze steady-state distributions and long-term behaviors.
- Discuss applications in queuing systems and reliability analysis.

Formative Assessment 2 (FA2):

- Solve a problem involving classification of states in a Markov chain.

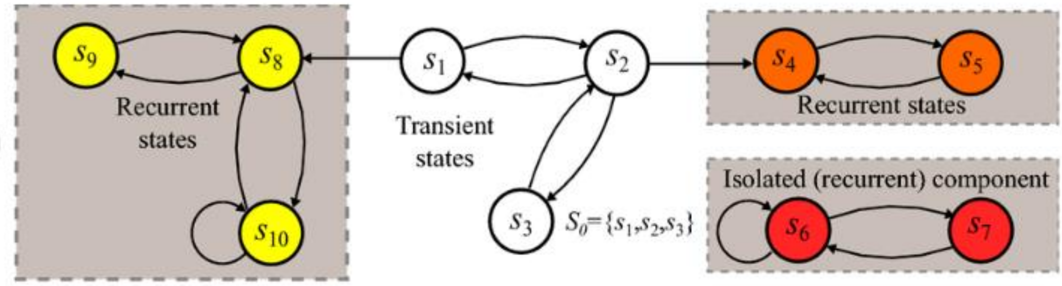
2.3 Taxonomy of Objectives:

	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual Knowledge	1		2			
Conceptual Knowledge		1		2		1
Procedural Knowledge			2		3	
Meta-Cognitive Knowledge				3		

2.4 Key Words:

- Markov Chains
- Transition Matrix
- Recurrent and Transient States
- Periodic and Aperiodic States
- Steady-State Distribution

2.5 Key Diagrams:



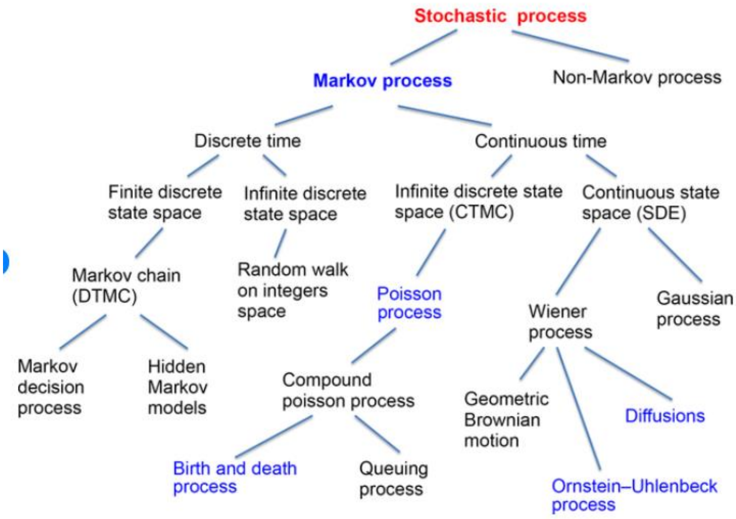
- Graphical representation of state transitions.
- Transition probability matrix examples.
- Classification of states using directed graphs.

PowerPoint Presentation:
https://in.docworkspace.com/d/sIELI7tg30LKzvQY?sa=601.1094

3. Discussion:

- Compare different types of Markov chains and their state classifications.
- Discuss real-world applications such as:
  - Weather prediction models.
  - Internet browsing behavior.
  - Queueing systems in service industries.

4. Mind Map:



- Central Concept: Classification of States in Markov Chains
  - Subtopics: Recurrent/Transient, Periodicity, Absorbing Chains, Applications.

5. Summary:

- Markov chains are stochastic models used to predict system evolution over time.
- States can be classified as recurrent, transient, periodic, or absorbing.

- Steady-state probabilities provide insight into long-term behavior.
- Applications range from economics to computer science and engineering.

6. Assessment through Questions/Analogy/New Ideas:

- Identify the recurrent states in a given Markov chain.
- Explain the significance of periodic states.
- Solve a problem related to steady-state probabilities.

7. FAQs: MCQs/Descriptive Questions:

- What is a Markov chain?
- Define recurrent and transient states with examples.
- What is the significance of steady-state probabilities?
- How do Markov chains apply to queueing models?

8. References:

- J. Medhi, *Stochastic Processes*, New Age International, 2009.
- S. Karlin & H. Taylor, *A First Course in Stochastic Processes*, Academic Press, 1975.
- W. Feller, *An Introduction to Probability Theory and Its Applications*, Wiley, 1968.

9. Verified by Subject Expert:

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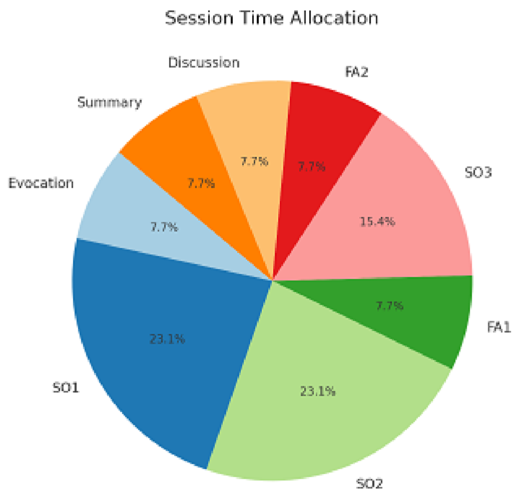
Course In-charge | Approved by HoD

Programme	M.Sc. Mathematics
Semester	II
Course Title	Operations Research
Course Code	21PMAE21
Hours	4
Total Hours	60
Credits	3
Max Marks	100
Unit & Title	Unit III – Deterministic Single and Multiple Item Static Model
Name of the Faculty	Dr. P. Anbarasi Rodrigo
T-L tools	Mind Maps, PowerPoint, Group Discussion, 3D Visualization

Pre-requisite Knowledge: Basic understanding of optimization, demand forecasting, and supply chain fundamentals.

Micro-Planning: 60 minutes



Phase	Time (Minutes)
Evocation	5 min
SO1	15 min
SO2	15 min
FA1	5 min
SO3	10 min
FA2	5 min
Discussion	5 min
Summary	5 min

1. Topics for Learning through Evocation

- Introduction to inventory management using real-world examples like warehouses, retail stores, and production units.
- Discussing the role of deterministic models in optimizing stock levels and minimizing holding costs.

2. Topic Introduction

2.1 General Objective:

To understand deterministic inventory models for single and multiple items and their applications in decision-making.

2.2 Specific Outcomes:

- **SO1:** Define inventory and describe deterministic models.
- **SO2:** Differentiate between single and multiple item static models and their assumptions.
- **SO3:** Apply deterministic inventory models to optimize stock levels and reduce costs.

First Phase:

SO1:

- Define inventory and its classification.
- Explain deterministic inventory models and their assumptions.
- Introduce the Economic Order Quantity (EOQ) model and its mathematical derivation.

SO2:

- Differentiate between single and multiple item static models.
- Explain constraints such as budget, storage, and resource limitations.
- Analyze EOQ variations: Quantity Discount Model, Backorder Model.

Formative Assessment 1 (FA1)

- Quick quiz: Identify different types of deterministic inventory models.

Second Phase:

SO3:

Discuss practical applications of EOQ and Multi-Item Inventory Models.

- Solve numerical examples related to EOQ and its variations.
- Introduce Joint Replenishment Problem (JRP) and its applications.

Formative Assessment 2 (FA2)

- Solve a numerical problem using EOQ and multiple-item constraints.

2.3 Taxonomy of Objectives:

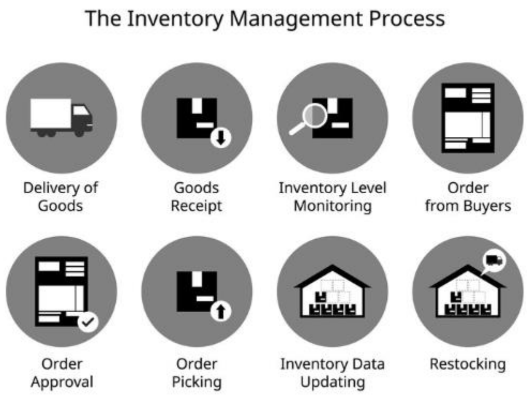
	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual Knowledge	1					
Conceptual Knowledge		1				1
Procedural Knowledge			1		1	
Meta-Cognitive Knowledge				1		

2.4 Key Words:

- Inventory Models
- Economic Order Quantity (EOQ)
- Multi-Item Models

- Stock Replenishment
- Lead Time
- Demand Forecasting

2.5 Key Diagrams:



Graphical representation of EOQ Model.

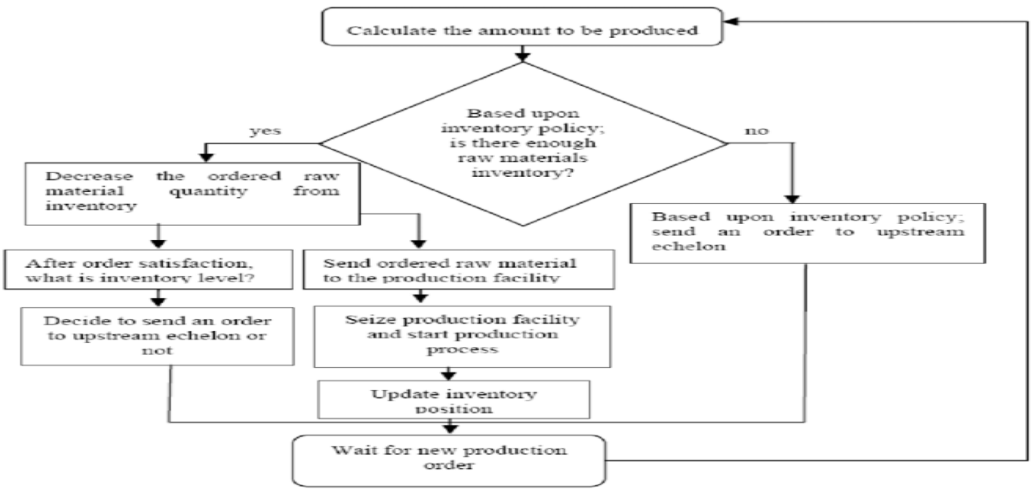
- Flowchart of single vs. multiple item static inventory models.
- Budget and storage constraint representations.

PowerPoint Presentation: https://in.docworkspace.com/d/sICXI7tg3rbKzvQY?sa=601.1094

3. Discussion

- Real-world applications of deterministic inventory models in logistics, healthcare, and manufacturing.
- The impact of technology (e.g., AI, automation) on inventory optimization.

4. Mind Map



5. Summary

- Deterministic inventory models help businesses manage stock efficiently and minimize costs.
- EOQ is a fundamental concept in single-item models, while multiple-item models consider additional constraints.
- Understanding lead time and demand forecasting is crucial in inventory optimization.

6. Assessment through Questions/Analogy/New Ideas:

- Derive the EOQ formula and explain its practical significance.
- Compare single and multiple-item static models with examples.
- Solve a case study involving multi-item inventory constraints.

7. FAQs: MCQs/Descriptive Questions

1. Define inventory and describe its types.
2. Derive the EOQ model and discuss its assumptions.
3. Differentiate between single-item and multiple-item static models.
4. How do budget constraints affect inventory decision-making?
5. Solve an example involving quantity discounts in EOQ.

8. References:

- Taha, H. *Operations Research: An Introduction*, Pearson.
- Silver, Pyke, and Peterson. *Inventory Management and Production Planning & Scheduling*, Wiley.
- Chopra, S., and Meindl, P. *Supply Chain Management: Strategy, Planning, and Operation*, Pearson.

9. Verified by Subject Expert:

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Course In-charge .

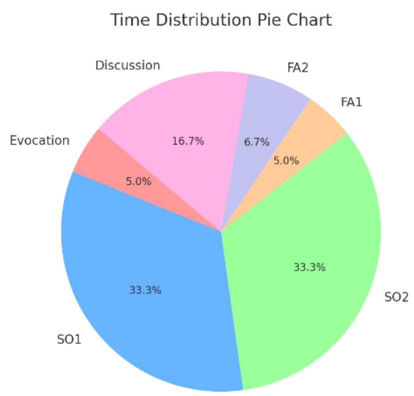
Approved by HoD

Lesson Plan

Programme	M.Sc. Mathematics
Semester	III
Course Title	Topology
Course Code	21PMAC31
Hours	6
Total Hours	90
Credits	4
Max Marks	50
Unit & Title	Unit I – Topological Spaces
Name of the Faculty	Dr.P.Anbarasi Rodrigo
T-L tools	PowerPoint, Group Discussion, Think-Pair-Share

Pre-requisite Knowledge: Basic understanding of set theory, functions, open and closed sets in metric spaces

Micro-Planning: 60 minutes



1. Topics for Learning through Evocation

Briefly introduce real-world examples of topology, such as networks, surfaces, and shapes in daily life.

2. Topic Introduction

2.1 General Objective:

- To understand the concept of topological spaces and their significance in mathematics.
- To learn fundamental properties and examples of topological spaces.

2.2 Specific Outcomes:

- **SO1:** Define topological spaces, open sets, and basis for a topology.
- **SO2:** Understand and analyze examples of topological spaces such as discrete, indiscrete, and standard topology on real numbers.

First Phase

SO1 (10 minutes)

- Define a **topological space** as a set X along with a collection of subsets τ that satisfy the axioms of topology.
- Introduce **open sets** and explain how they generalize the notion of open intervals in metric spaces.

SO2 (10 minutes)

- Explain different **types of topologies**:
  - **Discrete topology:** Every subset is open.
  - **Indiscrete topology:** Only X and ∅ are open.
  - **Standard topology on R** with open intervals.
- Discuss the significance of different types of topologies in real-world applications.

FA1 (Formative Assessment 1 – 3 minutes)

- Ask students to determine whether a given set with a given collection of subsets forms a topology.

Second Phase

SO1 (10 minutes)

- Introduce **basis for topology** and show how topologies can be generated using bases.
- Provide examples of basis elements for the standard topology on R.

SO2 (10 minutes)

- Explain **closure properties** of topologies (arbitrary unions and finite intersections of open sets remain open).
- Introduce subspace topology and product topology with simple examples.

FA2 (Formative Assessment 2 – 4 minutes)

- Quick quiz: Identify which of the given collections of subsets form a topology.

3. **Discussion** (10 minutes)

- Engage students in a conversation on why topological spaces are important in different fields of mathematics, including analysis, algebra, and geometry.
- Encourage students to think about how topology can be applied in computer science, physics, and network theory.

4. **Summary** (2 minutes)

- Summarize the definition and types of topological spaces.
- Recap the role of bases and closure properties in defining topologies.
- Conclude with real-world applications of topology.

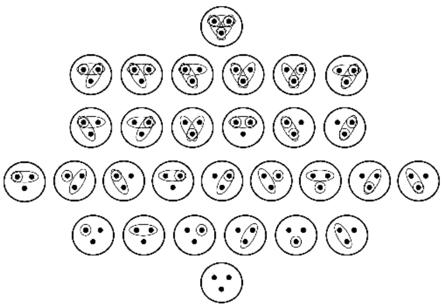
5. Taxonomy of Objectives

Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1					
B. Conceptual Knowledge		1				
C. Procedural Knowledge			2		2	
D. Meta-Cognitive Knowledge				2		

6. Key Words

- Topological space
- Open and closed sets
- Basis for topology
- Discrete and indiscrete topology
- Subspace topology

7. Key Diagrams



- Diagram illustrating different topologies on a set with three elements.
- Visualization of open sets in standard topology on R.
- Powerpoint Presentation
  https://in.docworkspace.com/d/sIHOA0OVS-eiWvQY

8. Assessment through Questions/Analogy/New Ideas

- Provide students with a new set and collection of subsets and ask them to verify if it forms a topology.

9. FAQ's (MCQ's/Descriptive Questions)

1. **Multiple Choice Questions:**
   - Which of the following is a topology on X={a,b,c}?
   - In which topology are all subsets open?
   - What is the basis for the standard topology on R?
2. **Descriptive Questions:**
   - Define a topological space with an example.
   - Differentiate between discrete and indiscrete topology.
   - Explain the significance of basis in topology.

10. References

- Munkres, J. R. Topology, Pearson, 2000.
- Simmons, G. F. Introduction to Topology and Modern Analysis, McGraw-Hill, 1963.
- Willard, S. General Topology, Dover Publications, 2004.

11. Verified by Subject Expert:

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Course In – charge **Approved by HoD**

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc.Mathematics
Semester	III
Subject Title	Core II – Graph Theory
Code	21PMAC32
Hours	6
Total Hours	90
Credits	4
Max Marks	100
Unit &Title	Unit:IV– Edge coloring – Vizing theorem
Name of the Faculty	Ms.J.JenitAjitha
T-Ltools	**Lecture method, PPT, Group Discussion**

PrerequisiteKnowledge:

- **Knowledge of** Basics of **Graph Theory,** Concept of **Graph Coloring**and definition of **Chromatic Number** and **Coloring Types.**

.**Micro-planning**

1. **Topic for Learning through Evocation:**

 Edge Coloring and Vizing's Theorem

2. **Topic Introduction:**

Graph Coloring is an important concept in combinatorics and optimization. Edge Coloring assigns colors to edges such that no two edges sharing the same vertex have the same color. Vizing's Theorem classifies graphs into two types based on their chromatic index.

2.1 General Objective:

To understand the concept of edge coloring and its mathematical significance and to explore Vizing's Theorem and its implications in graph theory.

2.2 Specific Objectives:

Enable the students to:

1. Define Edge Coloring and understand its importance.
2. Learn about Chromatic Index and its properties.
3. Explain and prove Vizing's Theorem.
4. Apply edge coloring concepts to real-world problems like network optimization.

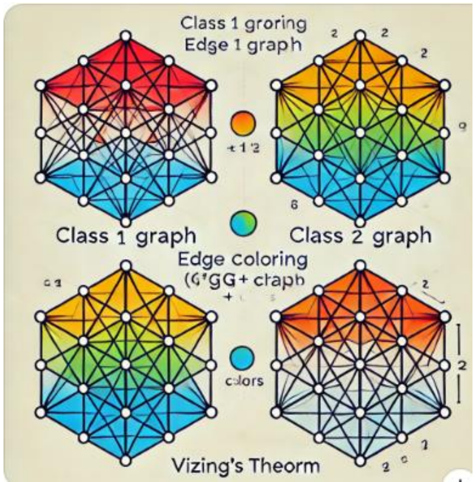
2.3Taxonomy of objectives:

TaxonomyofObjectives						
Knowledge Dimension	**TheCognitiveProcessDimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1	1,2				
B. Conceptual Knowledge		2		2		
C. Procedural Knowledge			3		3	
D. Meta-Cognitive Knowledge						4

2.4 Keywords: Graph Coloring, Edge Coloring, Chromatic Index, Vizing's Theorem, Class 1 & Class 2 Graphs.

2.5 Key diagram:

- ***Class 1 and Class 2 Graphs***

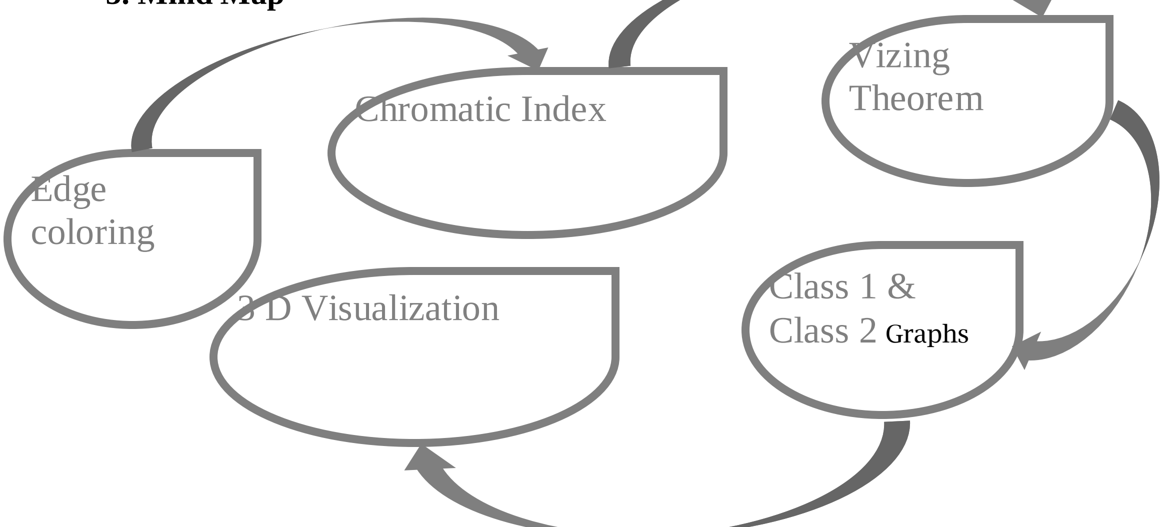


3. Power Point Presentation :
https://gamma.app/docs/Edge-Coloring-and-Vizings-Theorem-8inolwz8t0q9a1m

4. Group Discussion:

a) Edge Coloring Concept.
b)Understanding Vizing's Theorem
c) Applications of Edge Coloring.

5. Mind Map



6. Summary:

Edge Coloring ensures that no two edges sharing a vertex have the same color.**Vizing's Theorem** states that the chromatic index is either $\Delta(G)$or $\Delta(G) + 1$.**Applications** of edge coloring include **scheduling, optimization, and network design**.

7. Assessment:

- **Short answer questions: Define Edge Coloring and Vizing's Theorem.**
- **Problem-solving: Find the chromatic index for given graphs.**
- **Application-based: Use edge coloring to optimize real-world scenarios.**?

8. FAQs:

a. What is the difference between edge coloring and vertex coloring?
b. What is the chromatic index of a bipartite graph?
c. What are real-world uses of edge coloring?
d. How does Vizing's Theorem classify graphs?

9. References:

- Graph Theory Textbooks
- Research Papers on Edge Coloring &Vizing's Theorems

Verified By Subject Expert

Approved By HOD

Dr. P. ANBARASI RODRIGO
Assistant Professor in Mathematics
Research Department of Mathematics
St. Mary's College (Autonomous)
Thoothukudi - 628 001.

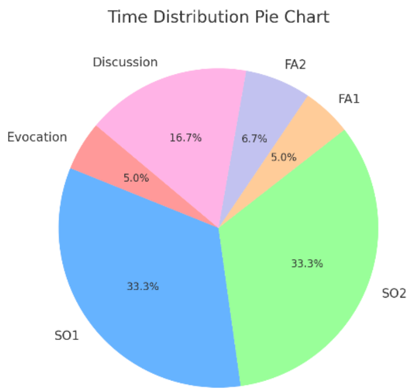
Lesson Plan

Programme	M.Sc. Mathematics
Semester	III
Course Title	Measure Theory
Course Code	21PMAC33
Hours	5
Total Hours	75
Credits	4
Max Marks	50
Unit & Title	Unit I – Lebesgues Measure
Name of the Faculty	P. Suganya
T-L tools	PowerPoint, Group Discussion, Think-Pair-Share

Pre-requisite Knowledge

- Basic understanding of set theory and real analysis.
- Concept of sigma-algebra and measurable sets.

Micro-Planning (60 minutes)



1. Topics for Learning Through Evocation

- Introduce the idea of measuring sets beyond simple length.
- Discuss limitations of Riemann integration and why Lebesgue measure is necessary.
- Ask students to consider how we can measure irregular sets.

2. Topic Introduction

2.1 General Objective:

- To introduce Lebesgue measure as a foundation for Lebesgue integration.
- To differentiate between Riemann and Lebesgue measures.

2.2 Specific Outcomes:

- Understand the definition of Lebesgue outer measure and measurable sets.
- Learn properties of Lebesgue measure, including countable additivity.
- Explore examples of measurable and non-measurable sets.

First Phase:
SO1 (10 minutes): Define Lebesgue outer measure and provide examples. Explain the covering method using intervals.

SO2 (10 minutes): Introduce the concept of measurable sets and the Carathéodory criterion.

Second Phase:
SO1 (10 minutes): Discuss properties of Lebesgue measure (monotonicity, countable additivity, translation invariance).

SO2 (10 minutes): Explore examples, including non-measurable sets like the Vitali set.

Summary (2 minutes):

- Highlight key differences between Riemann and Lebesgue measures.
- Recap measurable sets and properties.

2.3 Taxonomy of Objectives:

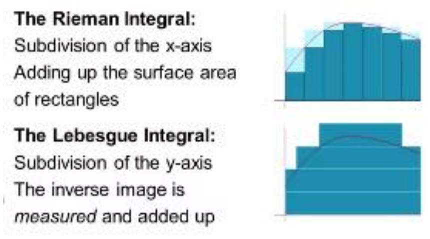
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1	1				
B. Conceptual Knowledge		3	1			
C. Procedural Knowledge				3	2,3	
D. Meta-Cognitive Knowledge						3

2.4 Key Words:

- Outer measure
- Measurable sets
- Countable additivity
- Non-measurable sets

2.5 **Key Diagrams:**

- Pictorial representation of comparison on Lebesgue and Riemann integral.



- Powerpoint Presentation: https://in.docworkspace.com/d/sIHyA0OVS4pSzvQY?sa=601.1094&ps=1&fn=Lebesgue%20Measure.pptx

3. Discussion:

- Why is Lebesgue measure superior to Riemann integration?
- Can we construct a non-measurable set in an intuitive way?
- What are real-world applications of Lebesgue measure?

4. Summary:

Lebesgue measure extends the idea of length to more general sets, using outer measure and measurable sets. It provides a foundation for modern integration, overcoming limitations of Riemann integration. Key properties include countable additivity and translation invariance.

5. Assessment Through Questions/Analogy/New Ideas:

Formative Assessment 1 (FA1) (3 minutes):

- Ask students to define Lebesgue outer measure and compare it with Riemann measure.

Formative Assessment 2 (FA2) (3 minutes):

- Give a short quiz on properties of Lebesgue measure.

6. FAQ's: MCQ's/ Descriptive Questions:

1. What is Lebesgue outer measure, and how is it constructed?
2. Explain the Carathéodory criterion for measurable sets.
3. Why is Lebesgue measure countably additive but not finitely additive?
4. Give an example of a non-measurable set.
5. How does Lebesgue measure help in defining Lebesgue integration?

7. References:

- Royden, H.L., & Fitzpatrick, P. (2010). *Real Analysis*. Pearson.
- Rudin, W. (1987). *Real and Complex Analysis*. McGraw-Hill.
- Bartle, R.G. (1995). *The Elements of Integration and Lebesgue Measure*. Wiley.

11. Verified by Subject Expert:

P. Sujatha

Course In – charge **Approved by HoD**

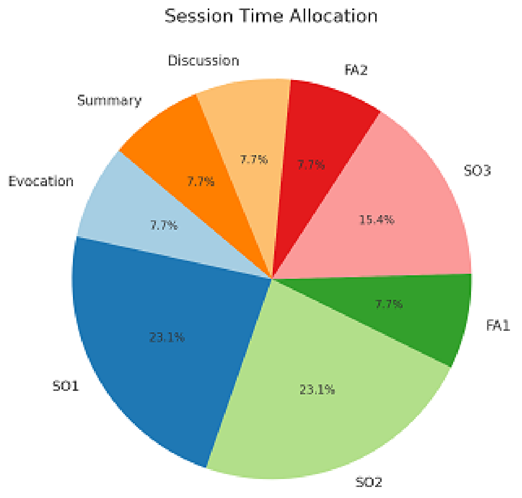
Dr. ANBARASI RODRIGO
Associate Professor in Mathematics
St. Mary's College (Autonomous)
Thoothukudi - 628 001.

Programme	M.Sc. Mathematics
Semester	III
Course Title	Partial Differential Equations
Course Code	21PMAC34
Hours	5
Total Hours	75
Credits	4
Max Marks	50
Unit & Title	Unit V – Laplace Equation and Wave Equation
Name of the Faculty	Dr. R. Maria Irudhaya Aspin Chitra
T-L tools	Mind Maps, PowerPoint, Group Discussion, 3D Visualization

Pre-requisite Knowledge:

Basic understanding of calculus, vector calculus, and fundamental solutions to differential equations.

Micro-Planning: 60 minutes



Phase	Time (Minutes)
Evocation	5 min
SO1	15 min
SO2	15 min
FA1	5 min
SO3	10 min
FA2	5 min
Discussion	5 min
Summary	5 min

1. Topics for Learning through Evocation

- Introduce Laplace’s equation in physical contexts such as electrostatics, fluid flow, and heat conduction.
- Discuss the importance of potential functions and equipotential surfaces.

2. Topic Introduction

2.1 General Objective:

To understand Laplace’s equation, its elementary solutions, and how equipotential surfaces help visualize solutions in physical applications.

2.2 Specific Outcomes:

- **SO1:** Define Laplace's equation and discuss its significance.
- **SO2:** Identify elementary solutions of Laplace's equation in different coordinate systems.
- **SO3:** Analyze families of equipotential surfaces and their applications.

First Phase:

SO1:

- Define Laplace's equation: $\nabla^2 u = 0$ in 2D and 3D.
- Discuss harmonic functions and their importance.
- Present examples in Cartesian, cylindrical, and spherical coordinates.

SO2:

- Discuss elementary solutions:
  - Linear solutions in Cartesian coordinates.
  - Radial solutions in polar, cylindrical, and spherical coordinates.
- Show examples of physical applications such as potential fields in electrostatics.

Formative Assessment 1 (FA1):

- Quick quiz: Identify which of the given functions satisfy Laplace's equation.

Second Phase:

SO3:

- Define equipotential surfaces and their significance.
- Demonstrate families of equipotential surfaces for different elementary solutions.
- Discuss applications in electrostatics and fluid dynamics.

Formative Assessment 2 (FA2):

- Solve a problem involving equipotential surfaces and field lines.

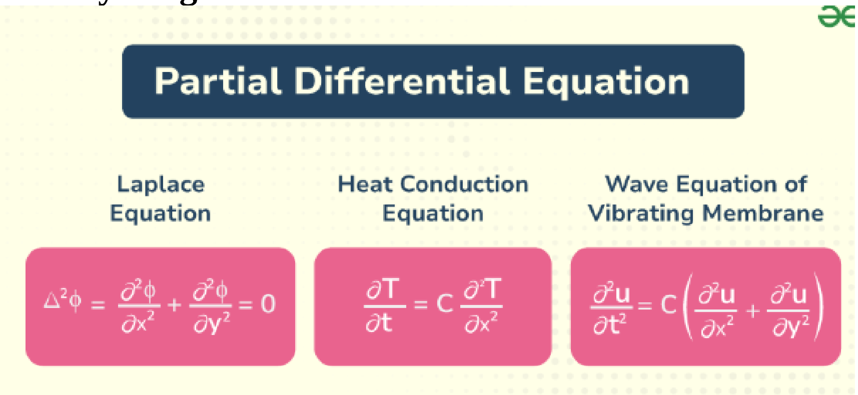
2.3 Taxonomy of Objectives:

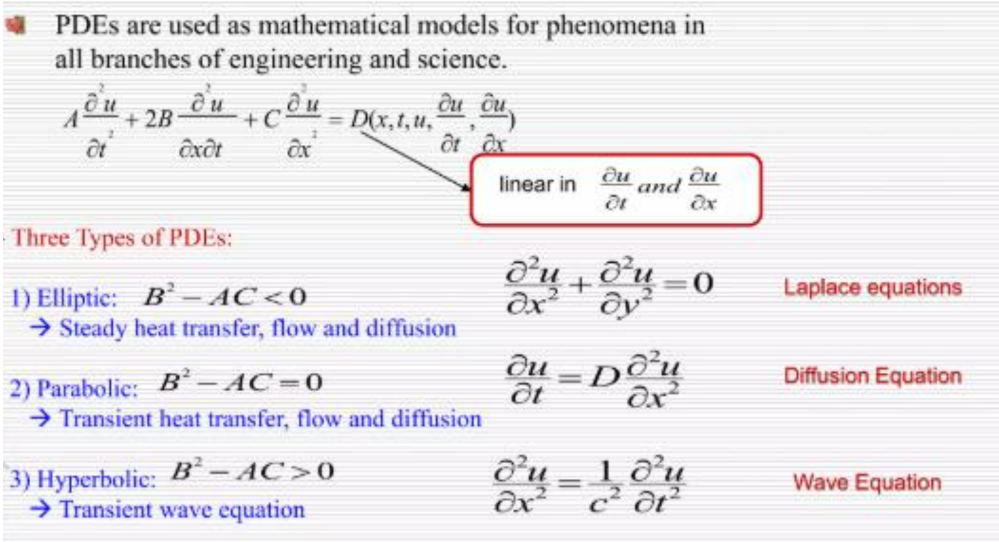
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual Knowledge	1					
Conceptual Knowledge		1		2		
Procedural Knowledge		2	1		2	
Meta-Cognitive Knowledge				3	3	

2.4 Key Words:

- Laplace's Equation
- Harmonic Functions
- Equipotential Surfaces
- Elementary Solutions
- Boundary Conditions

2.5 Key Diagrams:



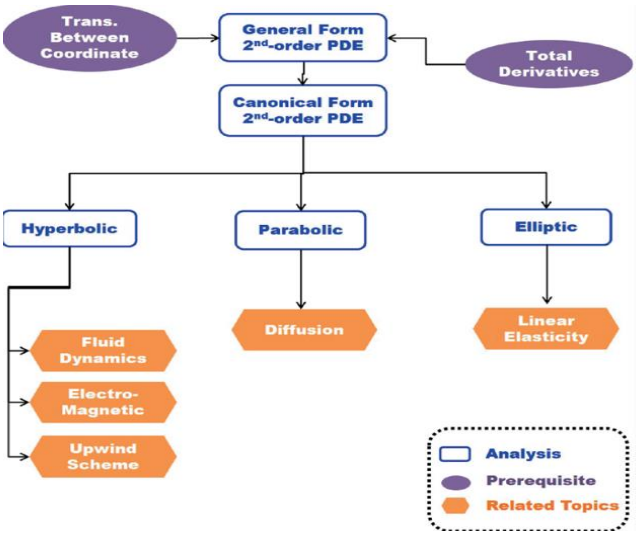


- Graphical representation of solutions in different coordinate systems.
- Equipotential surfaces for different types of solutions.
- Applications in electrostatics and fluid mechanics.
- Powerpoint Presentation: https://in.docworkspace.com/d/sID7I7tg3i7OzvQY?sa=601.1094

3. Discussion:

- Compare Laplace's equation with Poisson's equation.
- Discuss real-world applications such as:
  - Electrostatic potential in a capacitor.
  - Steady-state temperature distributions.
  - Gravitational potential in astrophysics.

4. Mind Map:



- Central Concept: Laplace's Equation
  - Subtopics: Harmonic Functions, Elementary Solutions, Equipotential Surfaces, Applications.

5. Summary:

- Laplace's equation models steady-state physical processes.
- Elementary solutions vary based on coordinate systems.
- Equipotential surfaces help visualize solutions.
- Applications in electrostatics, fluid flow, and heat conduction.

6. Assessment through Questions/Analogy/New Ideas:

- Show that a given function satisfies Laplace's equation.
- Describe the equipotential surfaces for in polar coordinates.
- Solve a problem involving Laplace's equation in a specific boundary condition.

7. FAQs: MCQs/Descriptive Questions:

- What is Laplace's equation?
- Give an example of an elementary solution in spherical coordinates.
- Why are harmonic functions significant in physics?
- How do equipotential surfaces help in visualizing solutions?

8. References:

- I. N. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, 1957.
- L. C. Evans, *Partial Differential Equations*, AMS, 1998.
- G. B. Arfken & H. J. Weber, *Mathematical Methods for Physicists*, Elsevier, 2005.

9. Verified by Subject Expert:

Course In-charge

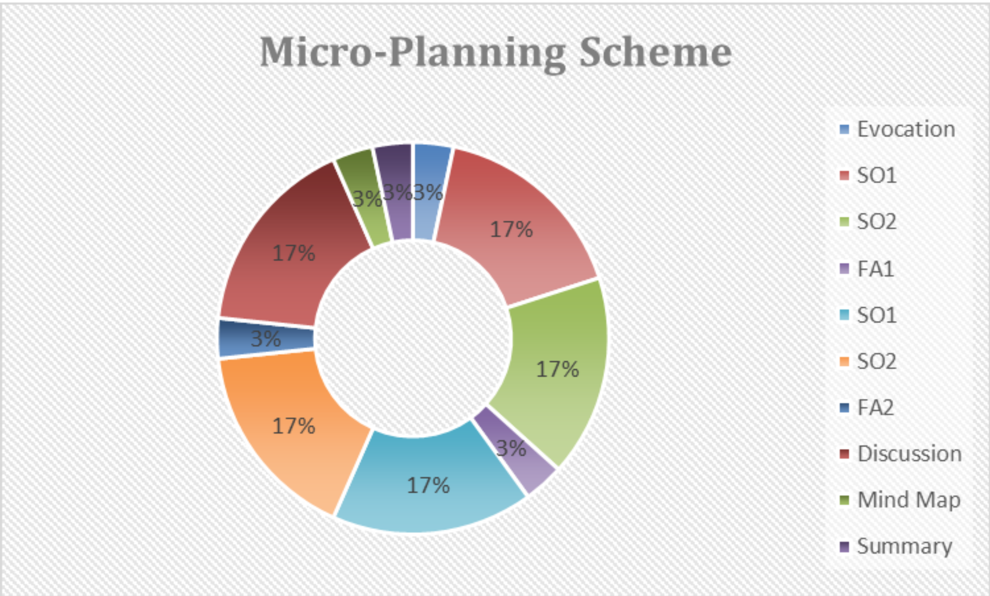
Approved by HoD

Lesson Plan

Programme	M.Sc. Mathematics
Semester	III
Course Title	Research Methodology
Code	21PMAC35
Hours	4
Total Hours	60
Credits	4
Max Marks	50
Unit & Title	Unit I - Types of Research
Name of the Faculty	Dr. C. Reena
T-L tools	Mind Maps, PowerPoint, Group Discussion

Pre-requisite Knowledge: Basic understanding of research concepts and terminology

Micro- Planning : 60 minutes



Evocation : 2 min
SO1 : 10 min
SO2 : 10 min
FA1 : 2 min
SO1 : 10 min
SO2 : 10 min
FA2 : 2 min
Discussion : 10 min
Mind Map : 2 min
Summary : 2 min

1. **Topics for learning through Evocation:**

- Definition and significance of research
- Different types of research

2. **Topic Introduction:**

2.1: General Objective:

- To provide an understanding of different types of research and their significance in academic and professional fields.

2.2: Specific Outcomes:

- Define research and its various types.
- Differentiate between qualitative and quantitative research.
- Develop an understanding of how to choose an appropriate research method

First Phase:

SO1 (10 minutes): Explain why research is necessary in various fields.

SO2 (10 minutes): Classification based on methodology: Qualitative vs. Quantitative Research

Second Phase:

SO1 (10 minutes): Discuss examples of each research type.

SO2 (10 minutes):

- Cross-sectional vs. Longitudinal Research
- Experimental vs. Non-experimental Research
- Case Studies and Surveys

Mind Map (2 minutes)

A graphical representation showing different types of research and their relationships.

Summary (2 minutes)

Recap of research types and their characteristics.

2.3:Taxonomy of objectives:

Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1					
B. Conceptual Knowledge		2		2		

C. Procedural Knowledge						3
D. Meta-Cognitive Knowledge						

2.4: Key words:

Research, Qualitative, Quantitative, Experimental, Descriptive, Applied

2.5: Key Diagram

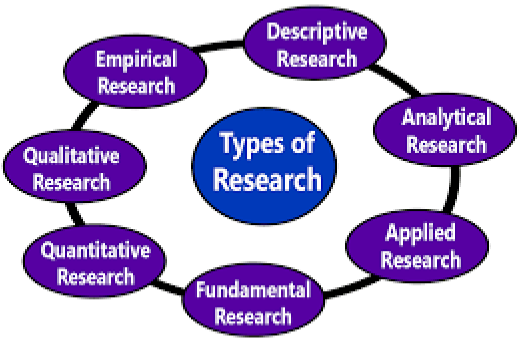
PowerPoint Presentation

https://gamma.app/docs/Untitled-76xlkjjpiiei6an

3. Discussion:

- Open-ended questions on the importance of different research types.
- Group activity: Identify types of research in given scenarios..

4. Mind Map



5. **Summary**

Recap of research types and their characteristics.

6. **Assessment through questions/analogy/new ideas:**

- Formative Assessment 1 (FA1) (2 minutes): Why is research important in academics and industry?
- Formative Assessment 2 (FA2) (2 minutes): How does applied research differ from basic research?

7. **FAQ's: MCQ's/ Descriptive Questions:**

1. Identify the correct research type from given options.

2. Explain how to choose an appropriate research method.

8. **References:**

- C.R. Kothari, Research Methodology, New Age International (P) Ltd Publishers.

• Leonie Elphinstone and Robert Schweitzer, How to get a research degree.

9. **Verified by Subject Expert:**

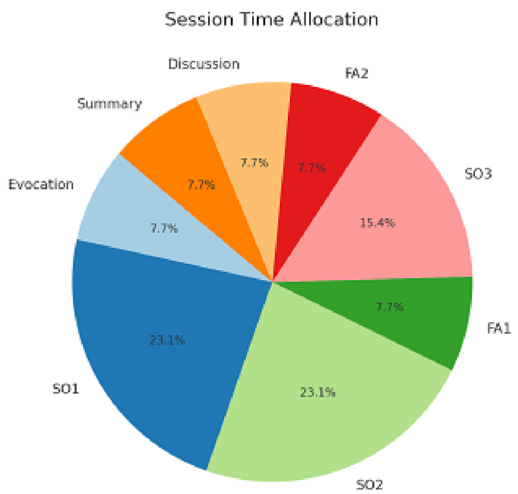
Dr. P. ANBARASI RODRIGO
Assistant Professor in Mathematics

Course In – charge **Approved by HoD**

Programme	M.Sc. Mathematics
Semester	III
Course Title	Fluid Mechanics
Course Code	21PMAE31
Hours	4
Total Hours	60
Credits	3
Max Marks	100
Unit & Title	Unit II – Pressure and its measurement
Name of the Faculty	Ms. P. Suganya
T-L tools	Mind Maps, PowerPoint, Group Discussion, 3D Visualization

Pre-requisite Knowledge: Basic understanding of force, pressure, and fluid properties.

Micro-Planning: 60 minutes



Phase	Time (Minutes)
Evocation	5 min
SO1	15 min
SO2	15 min
FA1	5 min
SO3	10 min
FA2	5 min
Discussion	5 min
Summary	5 min

1. Topics for Learning through Evocation

Introduce the concept of fluid pressure through real-life examples such as:

- Deep-sea diving and atmospheric pressure
- Hydraulic systems
- Variation in air pressure with altitude

2. Topic Introduction

2.1 General Objective:

- To understand the variation of pressure in a static fluid and derive fundamental equations governing the behavior of pressure in fluids.

2.2 Specific Outcomes:

- **SO1:** Define pressure at a point and explain its measurement.
- **SO2:** Derive and explain the hydrostatic law for pressure variation in a fluid at rest.
- **SO3:** Apply the concept to practical problems such as manometry and buoyancy.

First Phase:

SO1

Define pressure at a point in a fluid.

- Explain Pascal's Law and its significance.
- Discuss different types of pressure: Absolute, Gauge, Atmospheric, and Vacuum Pressure.
- Explain the working of a simple barometer and pressure gauges.

SO2

- Derive the hydrostatic equation: dP=−ρgdhdP = -\rho g dh
- Discuss the significance of pressure variation in different fluid layers.
- Explain pressure distribution in incompressible and compressible fluids.

Formative Assessment 1 (FA1)

- Quick quiz: Identify types of pressure in given scenarios.

Second Phase:

SO3

- Application of hydrostatic law in:
    - Manometry (U-tube and inclined manometers)
    - Buoyancy and flotation
- Practical problem-solving based on hydrostatic pressure.

Formative Assessment 2 (FA2)

- Solve a numerical problem on pressure variation in a tank.

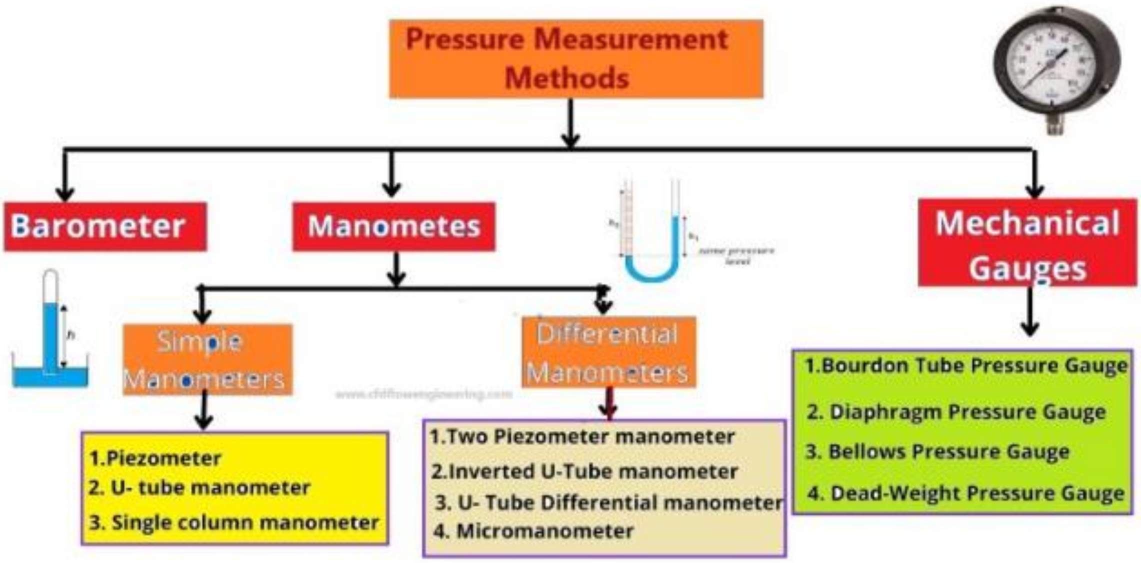
2.3 Taxonomy of Objectives:

Knowledge Dimension	The Cognitive Process Dimension					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	1					
Conceptual Knowledge		1				1
Procedural Knowledge			1		1	
Meta-Cognitive Knowledge				1		

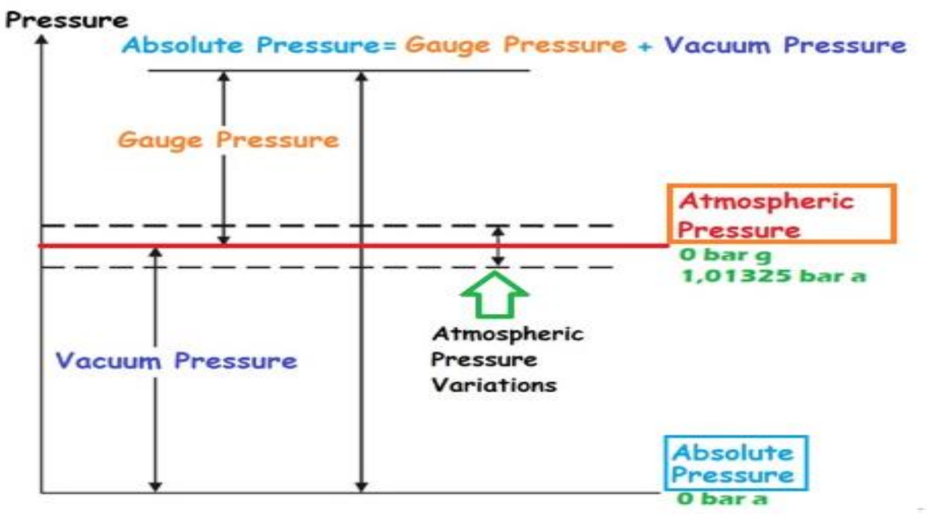
2.4 Key Words:

- Pressure
- Hydrostatic Law
- Pascal's Law
- Barometer
- Manometry
- Buoyancy

2.5 Key Diagrams:



Type of pressure measurement methods



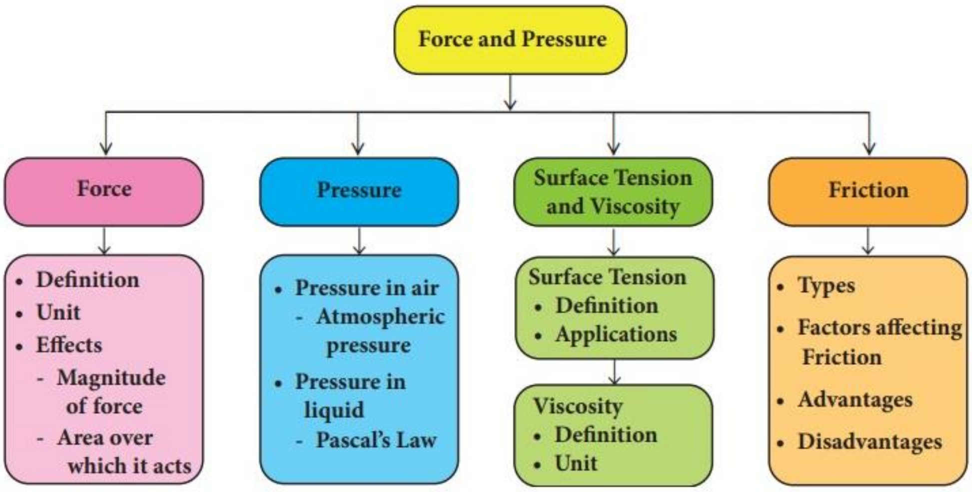
Pressure Datum absolute and Gauge Pressure

- Fluid column pressure variation diagram
- U-tube manometer diagram
- Free-body diagram for buoyancy
- Powerpoint Presentation: https://in.docworkspace.com/d/sIH3I7tg337GzvQY?sa=601.1094

3. Discussion

- Discuss real-world applications of hydrostatic pressure, such as submarines, aircraft, and dams.

4. Mind Map



5. Summary

- Hydrostatic pressure increases with depth.
- Pascal's Law forms the basis for hydraulic systems.
- Pressure measurement techniques and applications.

6. Assessment through Questions/Analogy/New Ideas:

1. Why does pressure increase with depth in a fluid?
2. How does a submarine control its depth using hydrostatic pressure principles?
3. Solve a problem involving a U-tube manometer.

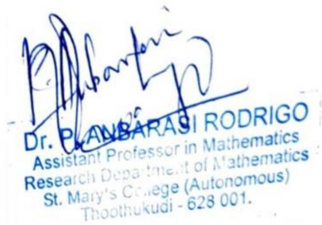
7. FAQs: MCQs/Descriptive Questions

1. Derive the equation for pressure variation in a static fluid.
2. Explain how a barometer measures atmospheric pressure.
3. What is the difference between absolute and gauge pressure?

8. References:

- J. Medhi, Stochastic Process, Wiley Eastern Limited, 1982.
- Cengel, Yunus A., and Cimbala, John M. Fluid Mechanics: Fundamentals and Applications. McGraw-Hill, 2013.
- White, Frank M. Fluid Mechanics. McGraw-Hill, 2011.

9. Verified by Subject Expert:



Course In-charge **Approved by HoD**

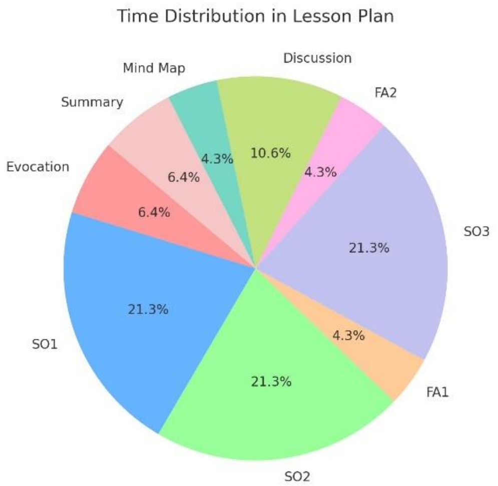
Lesson Plan

Programme	M.Sc. Mathematics
Semester	IV
Course Title	Complex Analysis
Course Code	21PMAC41
Hours	6
Total Hours	90
Credits	4
Max Marks	50
Unit & Title	Unit IV – Harmonic Function
Name of the Faculty	Dr.P.Anbarasi Rodrigo
T-L tools	Mind Map,PowerPoint, Group Discussion, Think-Pair-Share

Pre-requisite Knowledge

- Basic understanding of functions of a complex variable
- Fundamental concepts of partial derivatives
- Knowledge of the Cauchy-Riemann equations

Micro-Planning: 60 Minutes



1. Topics for Learning Through Evocation

- Start with a real-life analogy: "How does heat distribute in a metal plate over time?"
- Introduce the idea of **harmonic functions** as solutions to **Laplace's equation**, which governs steady-state heat conduction and fluid flow.

2. Topic Introduction

2.1 General Objective

- To understand the definition, properties, and applications of harmonic functions in complex analysis.

2.2 Specific Outcomes (SO)

- **SO1:** Define and identify harmonic functions in the context of complex analysis.
- **SO2:** Explore the relationship between harmonic functions and analytic functions using the Cauchy-Riemann equations.

First Phase: Fundamental Concepts

SO1 (10 minutes): Definition and Properties of Harmonic Functions

- **Definition:** A function u(x,y) is **harmonic** if it satisfies **Laplace's equation**:
- **Properties:**
  - Linear combinations of harmonic functions are also harmonic.
  - Harmonic functions satisfy the **mean value property**.
  - They exhibit **maximum and minimum principles**.

SO2 (10 minutes): Connection with Analytic Functions & Laplace's Equation

- If f(z)=u(x,y)+iv(x,y) is analytic, then both **u and v are harmonic**.
- The **Cauchy-Riemann equations** imply that u and v satisfy **Laplace's equation**.

FA1 (5 minutes): Quick Concept Check

- True/False: "Every harmonic function is necessarily analytic." (Answer: False)
- Identify whether given functions are harmonic.

Second Phase: Examples and Applications

SO1 (10 minutes): Examples of Harmonic Functions

- Work through differentiation to verify Laplace's equation.

SO2 (10 minutes): Applications

- Applications in physics and engineering:
  - Heat conduction
  - Electrostatics (potential functions)
  - Fluid dynamics

FA2 (5 minutes): Short Quiz or Problem-Solving Task

- Given a function, determine whether it is harmonic using partial derivatives.
- If f(z)is analytic, find a corresponding harmonic conjugate.

3. Discussion (5 min)

- Why are harmonic functions important in real-world applications?
- How does the mean value property connect to probability and statistics?

4. Mind Map (2 min)

- **Harmonic Function**
- **Examples**
- **Applications**

5. Summary (3 min)

- Harmonic functions satisfy **Laplace's equation** and appear in many applications.
- They are connected to **analytic functions** via the **Cauchy-Riemann equations**.
- Key properties include the **mean value property**, **maximum principle**

6. Taxonomy of Objectives

Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1					
B. Conceptual Knowledge		1				
C. Procedural Knowledge			2		2	
D. Meta-Cognitive Knowledge				2		

6. Key Words:

- Analytic Functions
- Laplace's Equation
- Cauchy-Riemann Equations
- Mean Value Property
- Maximum Principle

7. Key Points

Laplace Equations

$$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$$

$$\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$$

Powerpoint Presentation: https://s.wps.com/i8LZtgNhgvjH

8. Assessment through Questions/Analogy/New Ideas

- Find the harmonic conjugate of the function
- Show that the real and imaginary parts of f(z) are harmonic functions.
- Discuss how harmonic functions relate to **Fourier series** and boundary value problems.

7. FAQs: MCQs/Descriptive Questions

1. What equation must a function satisfy to be harmonic?
2. Explain why every analytic function produces a harmonic function.
3. Provide an example of a harmonic function and verify it.
4. How does the maximum principle apply to harmonic functions?
5. Explain the role of harmonic functions in electrostatics.

8. References

1. Ahlfors, L. **Complex Analysis** (McGraw-Hill, 1979).
2. Churchill, R.V. & Brown, J.W. **Complex Variables and Applications** (McGraw-Hill, 2013).
3. Saff, E.B. & Snider, A.D. **Fundamentals of Complex Analysis** (Pearson, 2003).

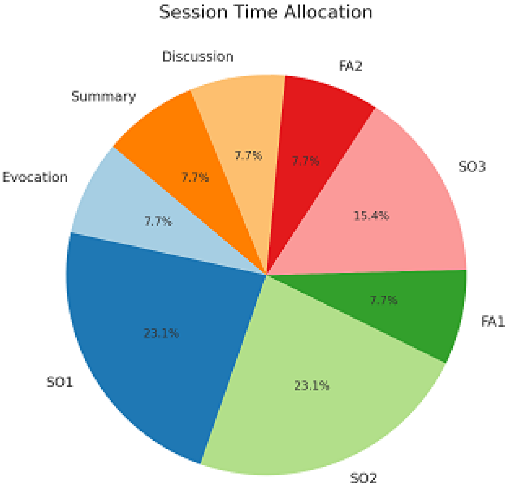
9. Verified by Subject Expert

Course In-charge: **Approved by HoD:**

Programme	M.Sc. Mathematics
Semester	III
Course Title	Functional Analysis
Course Code	21PMAC42
Hours	6
Total Hours	90
Credits	4
Max Marks	50
Unit & Title	Unit II – Orthogonal and Orthogonal Complements
Name of the Faculty	Dr. R. Maria Irudhaya Aspin Chitra
T-L tools	Mind Maps, PowerPoint, Group Discussion, 3D Visualization

Pre-requisite Knowledge: Basic understanding of vector spaces, inner product spaces, and subspaces.

Micro-Planning: 60 minutes



Phase	Time (Minutes)
Evocation	5 min
SO1	15 min
SO2	15 min
FA1	5 min
SO3	10 min
FA2	5 min
Discussion	5 min
Summary	5 min

1. Topics for Learning through Evocation

- Introduce the concept of orthogonality in real-life scenarios such as perpendicular forces in physics and least-square approximations in statistics.
- Discuss intuitive notions of perpendicularity and zero dot product.

2. Topic Introduction

2.1 General Objective:

To understand the concepts of orthogonality and orthogonal complements in inner product spaces and their significance in functional analysis.

2.2 Specific Outcomes:

- **SO1:** Define orthogonality and provide examples.
- **SO2:** Explain the concept of an orthogonal complement and its properties.
- **SO3:** Apply orthogonal projections to solve functional analysis problems.

First Phase:

SO1:

- Define orthogonality in inner product spaces.
- Explain properties of orthogonality with examples in finite-dimensional Euclidean spaces.
- Introduce the idea of an orthonormal set and basis.

SO2:

- Define the orthogonal complement of a subspace.
- Discuss fundamental properties such as:
  - (Double Orthogonal Complement Theorem)
  - Direct sum decomposition:
- Explain examples in finite and infinite-dimensional spaces

Formative Assessment 1 (FA1)

Quick quiz: Identify orthogonal vectors from given sets.

Second Phase:

SO3:

- Define and derive the formula for orthogonal projection.
- Application of orthogonal complements in solving least squares approximation problems.
- Discuss the Gram-Schmidt process for constructing an orthonormal basis.

Formative Assessment 2

Solve a numerical problem involving orthogonal projections in a Euclidean space.

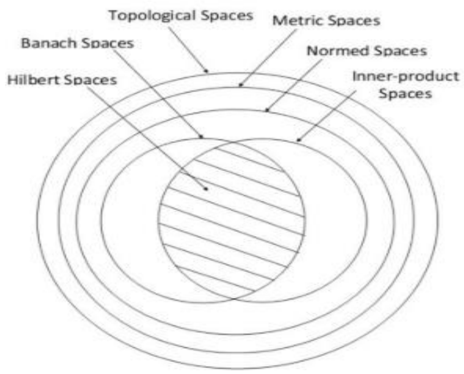
2.3 Taxonomy of Objectives:

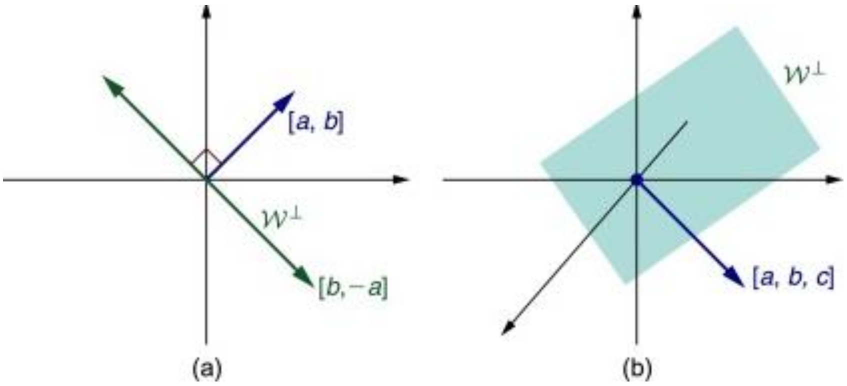
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual Knowledge	1					
Conceptual Knowledge		1		2		
Procedural Knowledge		2	2			
Meta-Cognitive Knowledge				3	3	

2.4 Key Words:

- Orthogonality
- Orthogonal Complement
- Inner Product Space
- Orthogonal Projection
- Gram-Schmidt Process

2.5 Key Diagrams:





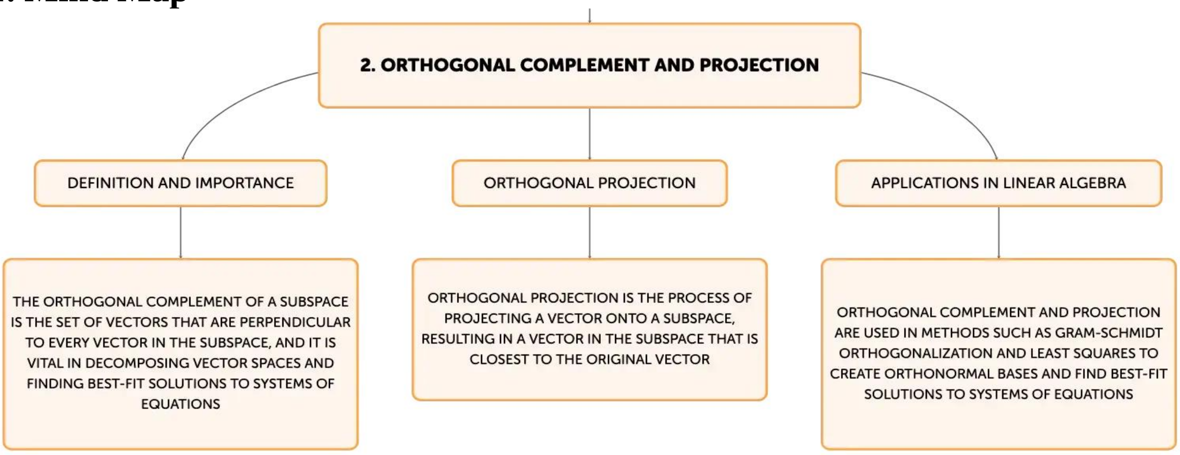
- Geometric representation of orthogonal vectors
- Diagram illustrating orthogonal complement in a subspace
- Projection of a vector onto a subspace
- Powerpoint Presentation:
  https://in.docworkspace.com/d/sID7I7tg3hrKzvQY?sa=601.1094

3. Discussion

Discuss real-world applications such as:

- Least squares approximation in statistics and regression analysis
- Principal Component Analysis (PCA) in machine learning
- Orthogonal polynomials in numerical analysis

4. Mind Map



5. Summary

- Orthogonality is a fundamental concept in inner product spaces.
- The orthogonal complement provides a way to decompose spaces.
- Orthogonal projection is essential in numerical approximations and functional analysis applications.

6. Assessment through Questions/Analogy/New Ideas:

1. Prove that in a finite-dimensional space.
2. Explain why the orthogonal projection is the closest approximation in a given subspace.
3. Solve a problem on Gram-Schmidt ortho-normalization.

7. FAQs: MCQs/Descriptive Questions

- Define orthogonality and give an example.
- Show that the intersection of a subspace and its orthogonal complement is $\{0\}$.
- Explain the role of the Gram-Schmidt process in functional analysis.
- Find the orthogonal projection of a given vector onto a given subspace.

8. References:

- Walter Rudin, *Functional Analysis*, McGraw-Hill, 1991.
- Kreyszig, Erwin. *Introductory Functional Analysis with Applications*, Wiley, 1989.
- Halmos, Paul R. *Finite-Dimensional Vector Spaces*, Springer, 1958.

9. Verified by Subject Expert:

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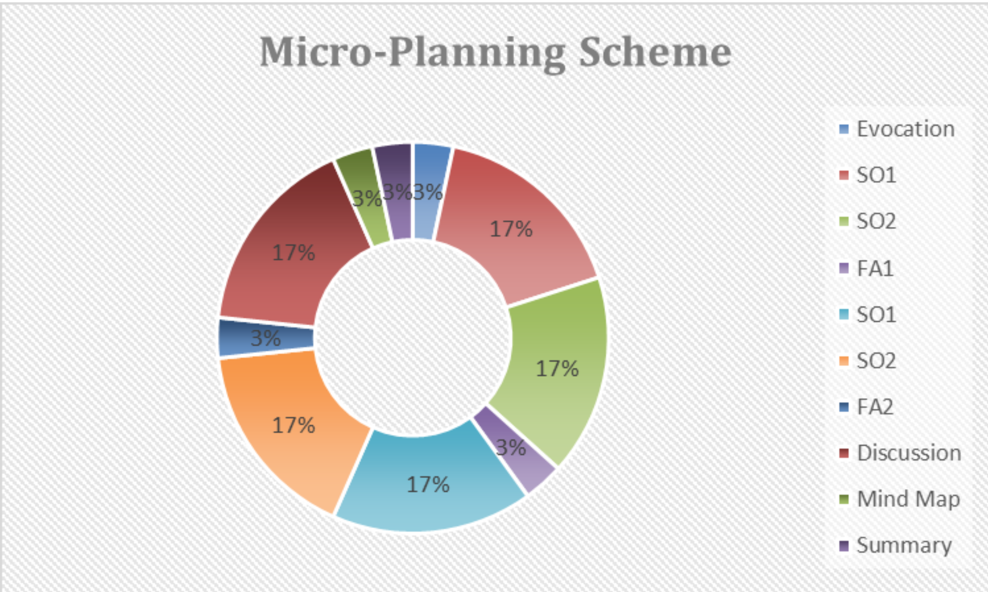
Course In-charge **Approved by HoD**

Lesson Plan

Programme	M.Sc. Mathematics
Semester	IV
Course Title	Number theory and Cryptography
Code	21PMAC43
Hours	5
Total Hours	75
Credits	6
Max Marks	50
Unit & Title	Unit V - Basics of Cryptography
Name of the Faculty	Dr. C. Reena
T-L tools	Mind Maps, PowerPoint, Group Discussion

Pre-requisite Knowledge: Basic understanding of number theory and Encryption and decryption principles

Micro- Planning : 60 minutes



Evocation : 2 min
SO1 : 10 min
SO2 : 10 min
FA1 : 2 min
SO1 : 10 min
SO2 : 10 min
FA2 : 2 min
Discussion : 10 min
Mind Map : 2 min
Summary : 2 min

1. **Topics for learning through Evocation:**
    - Importance of secure communication
    - Historical examples of cryptography
2. **Topic Introduction:**

2.1: General Objective:

- To understand the fundamental principles of cryptography and its real-world applications.

2.2: Specific Outcomes:

- Define Cryptography and its significance
- Explain different types of cryptographic techniques
- Explore cryptographic applications in real-world security systems

First Phase:

SO1 (10 minutes): Definition and purpose of cryptography

SO2 (10 minutes): Basic components: Plaintext, Ciphertext, Encryption, Decryption, Keys

Second Phase:

SO1 (10 minutes): Concept of Public and Private Keys

SO2 (10 minutes): Digital Signatures and Authentication

Mind Map (2 minutes)

Create a mind map connecting different cryptographic techniques and their uses

Summary (2 minutes)

Recap of key cryptographic concepts, importance, and real-world applications.

2.3: Taxonomy of objectives:

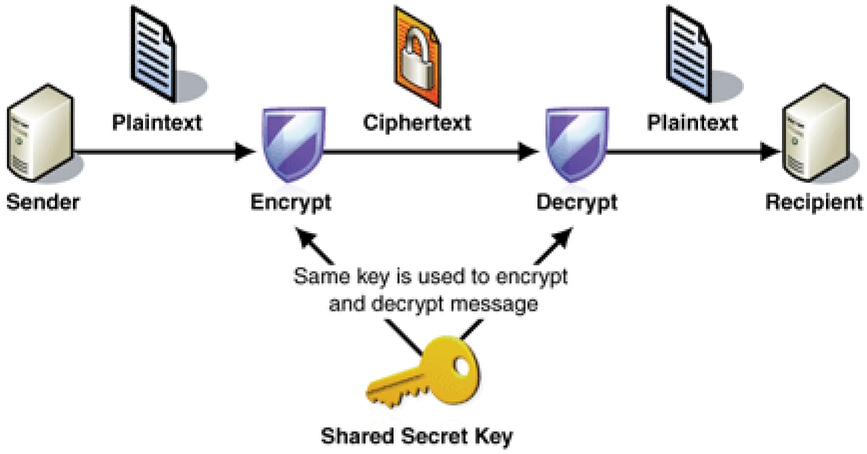
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1	2				
B. Conceptual Knowledge		2				
C. Procedural Knowledge				3		3
D. Meta-Cognitive Knowledge						

2.4: Key words:

Encryption, Decryption, Cipher, Key, Algorithm, Hashing and Digital Signature

2.5: Key Diagram

- Flowchart of Encryption-Decryption Process



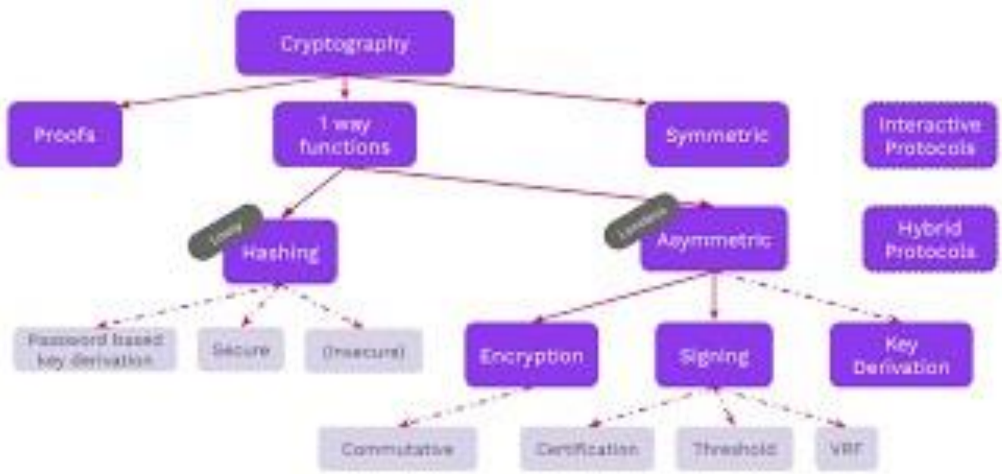
PowerPoint Presentation

https://gamma.app/docs/Cryptography-teo5v7vfh58xbty

3. Discussion:

- How does cryptography impact daily life?
- Ethical implications of encryption and decryption

4. Mind Map



5. Summary

Recap of key cryptographic concepts, importance, and real-world applications.

6. Assessment through questions/analogy/new ideas:

- Formative Assessment 1 (FA1) (2 minutes): Explain the difference between symmetric and asymmetric encryption
- Formative Assessment 2 (FA2) (2 minutes): Discuss an example of cryptography in cybersecurity

7. FAQ's: MCQ's/ Descriptive Questions:

1. What is cryptography?

2. What are the primary types of cryptography?

3. Explain the role of keys in cryptographic security.

4. What is the importance of hashing in cryptography?

8. References:

- William Stallings, "Cryptography and Network Security," Pearson.
- Bruce Schneier, "Applied Cryptography."
- Online Resources: NIST guidelines on Cryptography.

9. Verified by Subject Expert:

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Course In – charge **Approved by HoD**

LESSON PLAN

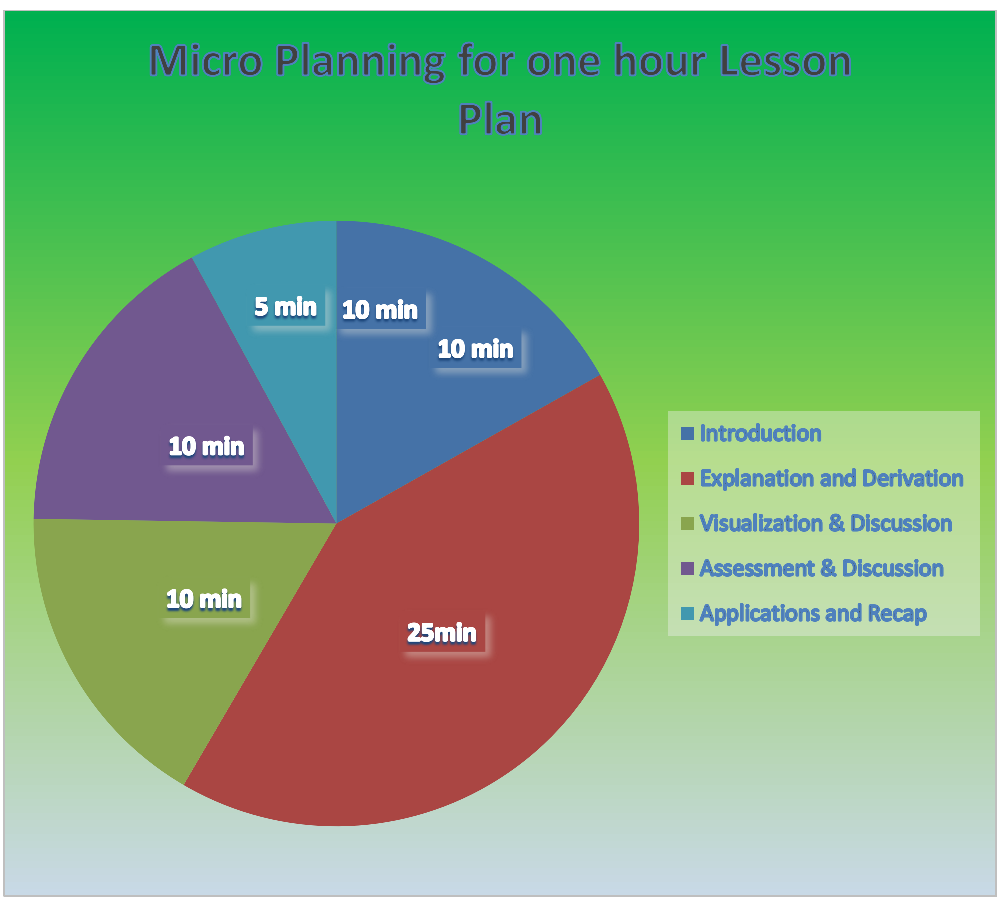
Objective Oriented Learning Process RBT

Programme	M.Sc. Mathematics
Semester	IV
Subject Title	Elective –Differential Geometry
Code	21PMAE41
Hours	5
Total Hours	75
Credits	4
Max Marks	100
Unit & Title	Unit III – Surface of Revolution – Anchor Ring
Name of the Faculty	Ms.P.Suganya
T-L tools	**Lecture method, PPT, Group Discussion**

Prerequisite Knowledge:

- **Knowledge** of Basics of **vectors** and **parametric equations**. Understanding of **surface of revolution.** Knowledge of **circular motion and coordinate geometry.**

Micro-planning



1. **Topic for Learning through Evocation:**
   Surface of Revolution and finding the position vector of Anchor ring (torus).
2. **Topic Introduction:**

   A surface of revolution is obtained by rotating a curve around a fixed axis. An anchor ring (also known as a torus) is a specific type of surface formed by revolving a circle around an external axis.

2.1 General Objective:

To understand and compute the position vector of an anchor ring using mathematical formulations.

2.2 Specific Objectives:

Enable the students to:

1. Define and describe a surface of revolution.
2. Understand the geometry of an anchor ring (torus).
3. Derive the parametric equation and position vector of an anchor ring.
4. Visualize and interpret the graphical representation of the anchor ring.

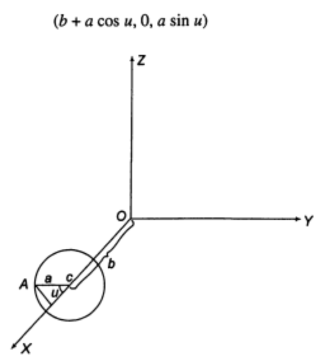
2.3Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1	1,2				
B. Conceptual Knowledge		2				
C. Procedural Knowledge			3		3	
D. Meta-Cognitive Knowledge						4

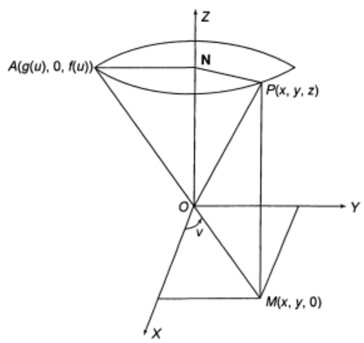
2.4 Keywords: Surface of Revolution, Torus (Anchor Ring), Position Vector, Parametric Equations.

2.5 Key diagrams :

- ***Representation of a point on an anchor ring***



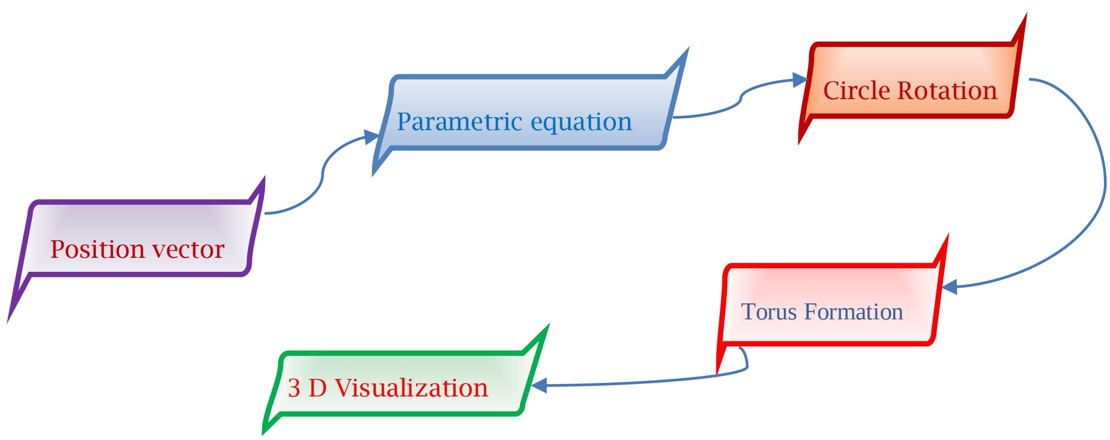
- **Surface of Revolution**



3. Power Point Presentation :
https://gamma.app/docs/Surfaces-of-Revolution-Unveiling-Anchor-Rings-r4yyz18tzihre09

4. Group Discussion:
a) Understanding the circle in the 3 D space.
b)Rotating the Circle Around the z-Axis to Form the Torus
c) Position Vector Representation.

5. Mind Map



6. Summary:

A **surface of revolution** is formed by rotating a curve. A **torus (anchor ring)** is generated when a circle rotates around an external axis.

7. Assessment:

- **Short Answer Questions:** Define a **surface of revolution** and an **anchor ring**.
- **Derivation Task:** Derive the **parametric equations** for a torus.
- Problem-Solving: Calculate the position vector of an anchor ring with given parameters.
- **Application-Based Question:** Where do **torus shapes** appear in real life?

8. FAQs:

1. **What is an anchor ring?**
   It is a torus, a **3D surface obtained by revolving a circle around an axis**.
2. **How is the position vector of a torus derived?**
   By **expressing coordinates in parametric form** based on the rotation of a circle.
3. **Where are anchor rings (tori) used?**
   In **physics (magnetic fields), engineering (mechanical parts), and graphics (3D modeling).**

9. References:

- Differential Geometry Textbooks

Verified By Subject Expert

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