ST. MARY'S COLLEGE (AUTONOMOUS), THOOTHUKUDI
Master of Science (Physics)
Course Structure (w. e. f 2021)

Semester – I

Subject	Course code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
					CIA	ESE	Total
Core I	21PPHC11	Classical Mechanics	6	5	40	60	100
Core II	21PPHC12	Mathematical Physics I	6	5	40	60	100
Core III	21PPHC13	Electronics and Experimental methods	6	5	40	60	100
Elective I	21PPHE11/ 21PPHE12	A. Crystal growth & Thin films B. Research Methodology	6	4	40	60	100
Core Practical I	21PPHCR1	Electronics	3				
Core Practical II	21PPHCR2	General Physics	3				
			30	**19**	**160**	**240**	**400**

Semester – II

Subject	Course code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
					CIA	ESE	Total
Core IV	21PPHC21	Mathematical Physics II	6	5	40	60	100
Core V	21PPHC22	Electromagnetic Theory	6	5	40	60	100
Core VI	21PPHC23	Thermodynamics and Statistical Mechanics	6	5	40	60	100
Elective II	21PPHE21/ 21PPHE22	A. Bio medical Instrumentation B.Microprocessor and Microcontroller	6	4	40	60	100
Core Practical I	21PPHCR1	Electronics	3	3	40	60	100
Core Practical II	21PPHCR2	General Physics	3	3	40	60	100
			30	**25**	**240**	**360**	**600**

Semester – III

Subject	Course code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
					CIA	ESE	Total
Core VII	21PPHC31	Quantum Mechanics – I	6	5	40	60	100
Core VIII	21PPHC32	Atomic and Molecular Spectroscopy	6	5	40	60	100
Core IX	21PPHC33	Solid State Physics- I	6	5	40	60	100
Elective III	21PPHE31/ 21PPHE32	A. Nano science and Technology B. Energy sources	6	4	40	60	100
Core Practical III	21PPHCR3	Microprocessor and Microcontroller& C++	3				
Core Practical IV	21PPHCR4	Advanced Electronics	3				
Self Study Course/ MOOC/ Internship (optional)	21PPHSS1/ 21PPHM2/ 21PPHI1	Physics for Lectureship	-	+2		100	100
			30	**19+2**	**240**	**360**	**500**

Semester – IV

Subject	Course code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
					CIA	ESE	Total
Core X	21PPHC41	Quantum Mechanics – II	6	5	40	60	100
Core XI	21PPHC42	Solid State Physics- II	6	5	40	60	100
Core XII	21PPHC43	Nuclear and Particle Physics	6	5	40	60	100
Core Project	21PPHP41	Project	6	6	40	60	100
Core Practical III	21PPHCR3	Microprocessor and Microcontroller& C++	3	3	40	60	100
Core Practical IV	21PPHCR4	Advanced Electronics	3	3	40	60	100
			30	**27**	**200**	**300**	**500**

Activity	Duration	Purpose
Evocation	2 min	To discuss real-world dynamic systems,

Programme	M. Sc Physics
Semester	I
CourseTitle	Classical Mechanics
Code	21PPHC11
Hours	6
TotalHours	90
Credits	5
MaxMarks	100
Unit &Title	UnitI:D' Alembert's principle
Nameofthe Faculty	Mrs. Saravana Selvi
T-L tools	Lecture method, Physical demonstrations (mass-spring system, inclined planes), and problem-solving sessions.

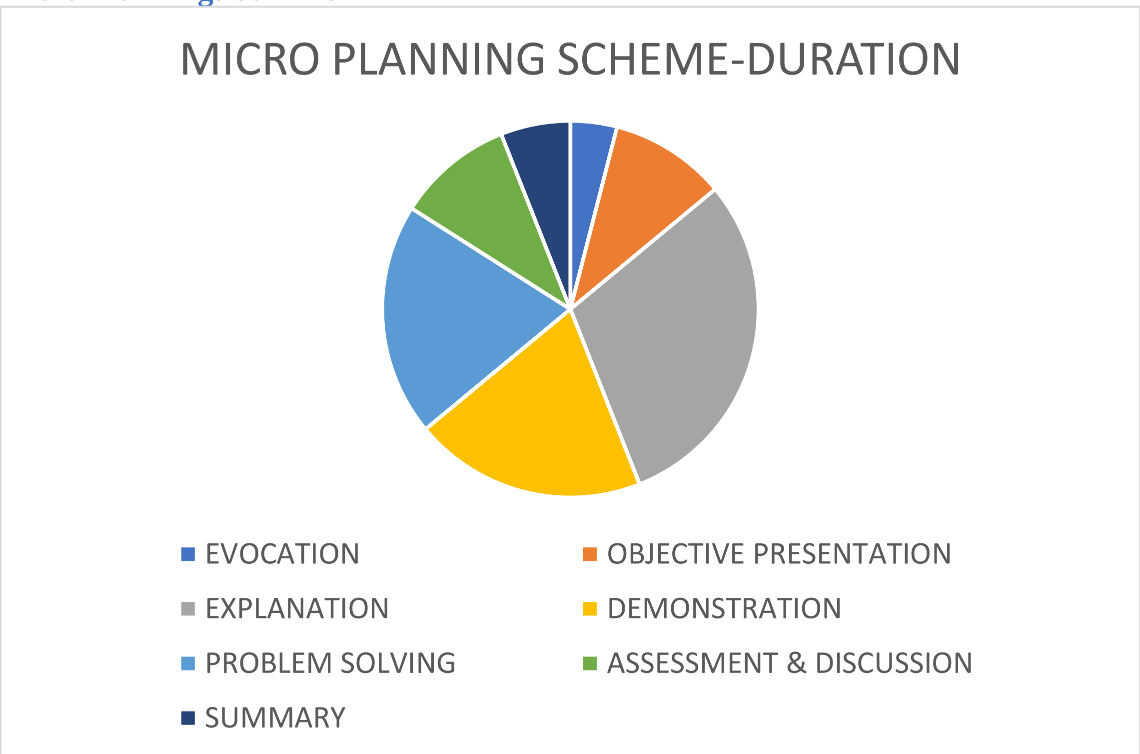
Pre-requisiteKnowledge:

- Basics of Newton's Laws of Motion.

- Concept of forces and acceleration.

- Knowledge of inertia and equilibrium conditions.

Micro-Planning: 60 mins



		such as vehicles moving uphill
Objective Presentation	5 min	To explain the purpose of D'Alembert's Principle in simplifying dynamic problems.
Explanation	15 min	To teach the theoretical basis of the principle with derivations.
Demonstration	10 min	Use animations or apparatus to illustrate the principle in action.
Problem Solving	10 min	To solve numerical problems based on the principle.
Assessment and Discussion	5 min	To address student questions and clarify doubts.
Summary	3 min	To recap the principle and its significance. |

Learning Objectives:

General Objective:

- ❖ Enable students to understand and apply D'Alembert's Principle to solve dynamic problems in mechanics.

Specific Objectives:

- ❖ State and derive D'Alembert's Principle.
- ❖ Explain the concept of inertial force.
- ❖ Apply the principle to analyze systems in dynamic equilibrium.
- ❖ Solve numerical problems involving forces and accelerations.

Key Topics:

1. Introduction to D'Alembert's Principle:
   - Statement of the principle: Transformation of a dynamic problem into a static one by introducing inertial forces.
   - Mathematical form:

$\sum \vec{F}$ - m$\vec{a}$ = 0

   - Relation to Newton's Second Law.

2. Inertial Forces:
   - Definition and significance of fictitious forces.
   - Examples in various systems (e.g., pendulum, blocks on inclined planes).

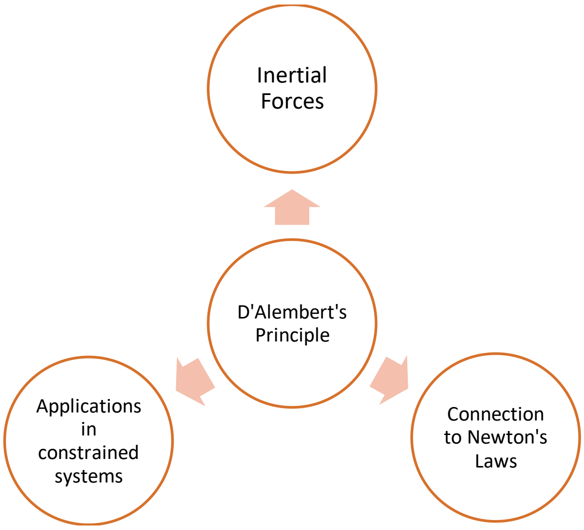
3. Applications of D'Alembert's Principle:
   - Analysis of constrained motion (e.g., pulleys and inclined planes).
   - Solving rigid body dynamics problems.

4. Numerical Examples:
   - Practical problems demonstrating the application of the principle

Taxonomy of Objectives:

Taxonomyof objectives						
Knowledge Dimension	TheCognitiveProcess Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A.FactualKnowledge	1					
B.ConceptualKnowledge		2	2			
C.ProceduralKnowledge				3	3	
D.MetaCognitive Knowledge					4	4

Mind Map:



Summary:

D'Alembert's Principle reinterprets dynamics as a problem of static equilibrium.

It introduces inertial forces to simplify the analysis of motion.

The principle is crucial for solving problems in classical and modern mechanics.

Assessment Questions:

1. Derive the mathematical expression for D’Alembert’s Principle.
2. Explain the concept of inertial force with an example.
3. Apply the principle to analyze the motion of a block on an inclined plane.
4. How does D’Alembert's Principle relate to Newton's Second Law?

References:

1. Goldstein, H., Poole, C., & Safko, J. Classical Mechanics.
2. Symon, K. R. Mechanics.
3. Gregory, R. D. Classical Mechanics.

Verified by Subject Expert:

Course In-charge

Approved by HoD

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	I
Subject Title	Mathematical physics I
Code	21PPHC12
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit & Title	Unit V: Group Theroy
Name of the Faculty	Ms. P.Padmavathi
T-L tools	Lecture method Visual aids: PPT, animations, and simulations. Demonstration: Group symmetry models ,Transformation matrices, character tables

Prerequisite Knowledge:

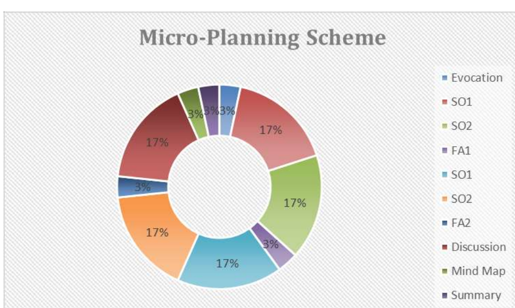
Students should have a basic understanding of:

Basic algebra and set theory

Understanding of matrices and their properties

Familiarity with vector spaces

Micro-Planning:



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. Topic for Learning Through Evocation

Introduce Group Theory by discussing real-life examples:

Symmetry in Nature (e.g., honeycomb structures, crystal lattices)

Application in Physics (e.g., conservation laws, quantum mechanics)

Historical Relevance (mention Évariste Galois and his contributions)

2. Topic Introduction:

1. Definition: A group is a mathematical structure consisting of a set and an operation that satisfies closure, associativity, identity, and inverse properties.

2. Types of Groups: Abelian and Non-Abelian Groups

3. Group Representations: Matrices as representations of group elementsIntroduce the significance of relativistic quantum mechanics:

3. Objectives:

3.1 General Objectives:

Enable students to understand the fundamental principles of Group Theory and its applications in Physics, particularly in quantum mechanics and crystallography.

3.2 Specific Objectives:

1. Define groups, subgroups, cosets, and normal subgroups.

2. Explain group homomorphism and isomorphism with examples.

3. Analyze Schur's Lemma and Great Orthogonality Theorem.

4. Construct character tables and apply them in physics.

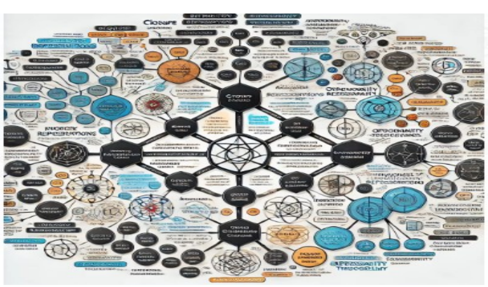
3.3 Taxonomy of Objectives:

Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

3.4 Key Words:

Group, subgroup, coset, homomorphism, isomorphism, irreducible representation, character table, Schur's Lemma, orthogonality theorem**.**

4.Mind map



5.Summary:

Students will learn how Group Theory helps describe symmetries in physical systems, particularly in quantum mechanics and crystallography. The emphasis will be on character tables, homomorphisms, and Schur's Lemma.

6.Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts

1. What are the four essential properties of a group?
2. Explain the difference between Abelian and Non-Abelian Groups.
3. How does Group Theory relate to Quantum Mechanics?
4. What is the significance of Schur's Lemma?

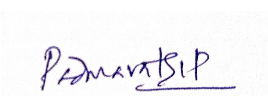
7.FAQs:

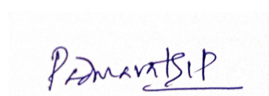
1. What is the identity element in a group?
2. How are group representations used in physics?
3. What are irreducible representations, and why are they important?
4. How do character tables help in analyzing symmetry operations?

8.References:

1. Satya Prakash – Mathematical Physics, 6th edition, Sultan Chand & Sons, 2019.
2. Dass H.K. – Mathematical Physics, 8th Edition, S. Chand & Company Ltd., 2018.
3. Chattopadhyay P. K. – Mathematical Physics, 2nd Edition, New Age International Publishers, 2013.

9. Verified by Subject Expert:





Course In-charge **Approved by HoD**

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSONPLAN

ObjectiveOrientedLearningProcessRBT

Programme	M.Sc Physics
Semester	I
Subject Title	Electronics and Experimental Methods
Code	21PPHC13
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit&Title	Unit II: Op-Amp applications -Triangular wave generator
Name of the Faculty	Mrs.Y.Sasikala
T-L tools	Lecture method,Visual aids:PPT, animations

Pre requisite Knowledge:

- Basic Electrical & Electronics Concepts
- Characteristics of Ideal & Practical Op-Amps
- Op-AmpConfigurations such as Comparator (for square wave generation),Integrator(to convert square wave to triangular wave), Schmitt Trigger (for waveform stabilization)

Micro-Planning:

Activity	Duration	Purpose
Evocation	5min	Generating Interest
Objective Presentation	5min	Learning goals
Explanation	20min	Theoretical Concepts
Demonstration	10min	Circuit Simulation and Visualization
Assessment and Discussion	10min	To ask questions in order to evaluate comprehension
Summary	10min	To recall key factors

1. **Evocation(5min) –Generating Interest**

- Real-world Example:Used in music synthesizers,FM modulation and signal processing.
- Show waveform comparison(sine,square,triangular)and ask:Why different waveforms?

2. **Objective Presentation (5min)–Learning Goals**

- Understand triangular wavegenerator principles.
- Learn how comparators and integrators generate triangular waves.
- Explore applications in signal processing and PWM circuits.

3. **Explanation (20min)–Theoretical Concepts**

- Working Principle:

  A Schmitt trigger (comparator) generates a square wave.

  An integrator(op-amp+capacitor)converts it into a triangular wave.

  Frequency Formula:

  f=1/2RC

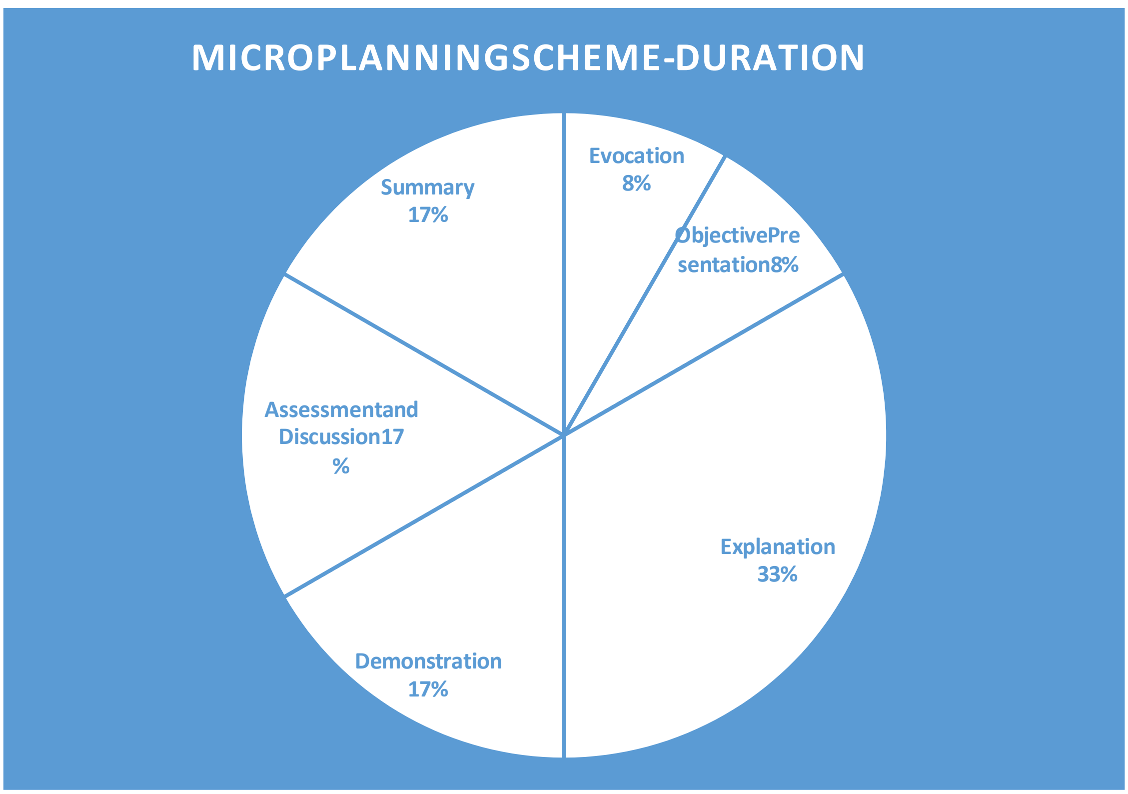
  (depends on resistance & capacitance).

- Comparison: Triangular vs. Square vs.Sine wave properties.

4. Demonstration (10min)–Circuit Simulation&Visualization
- Simulation (LTspice/Multisim):Show wave forms at different circuit stages.
- Hardware Demo(if available): Build circuit using 555Timer or Op-Amp(IC741), observe waveforms on oscilloscope.

5. Assessment & Discussion (10min)-To ask questions in order to evaluate comprehension
- Why use an integrator after a square wave generator?
- How does changing R and C affect frequency?
- Applications: Audio synthesis, function generators,motor control.

6. Summary(5min)–To recall key factors
- Triangular waves are generated by integrating square waves.
- RC values determine frequency and amplitude.
- Used in signal modulation,waveform generators and control circuits.



General Objective:

Enhance students'understanding of electronic circuits and their applications in real-world scenarios.

Specific Objectives:

- Generate Triangular Waveform–Consistent periodic output.
- Ensure Linearity–Linear rise and fall in voltage.
- Adjustable Parameters–Control frequency and amplitude.
- Square toTriangular Conversion–Using an integrator circuit.
- Signal Processing Use–Test signal in electronics.
- Synchronization–Phase-locked applications.
- Low Distortion–Minimizen on-linearity.
- Circuit Compatibility–Used infunction generators & modulation.

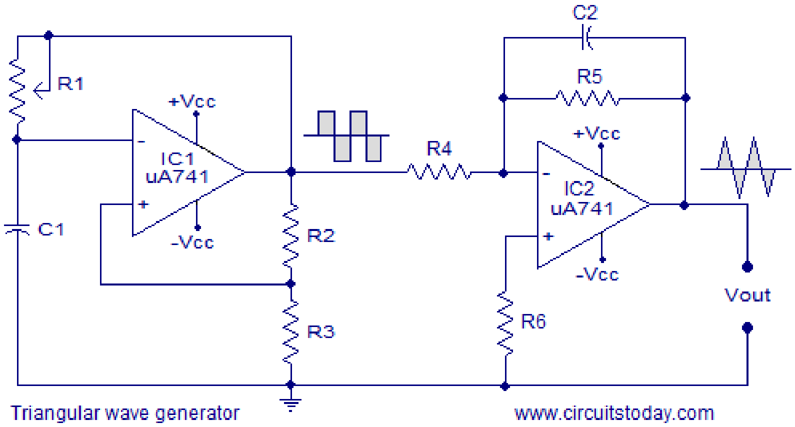
Taxonomy of Objectives:

Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

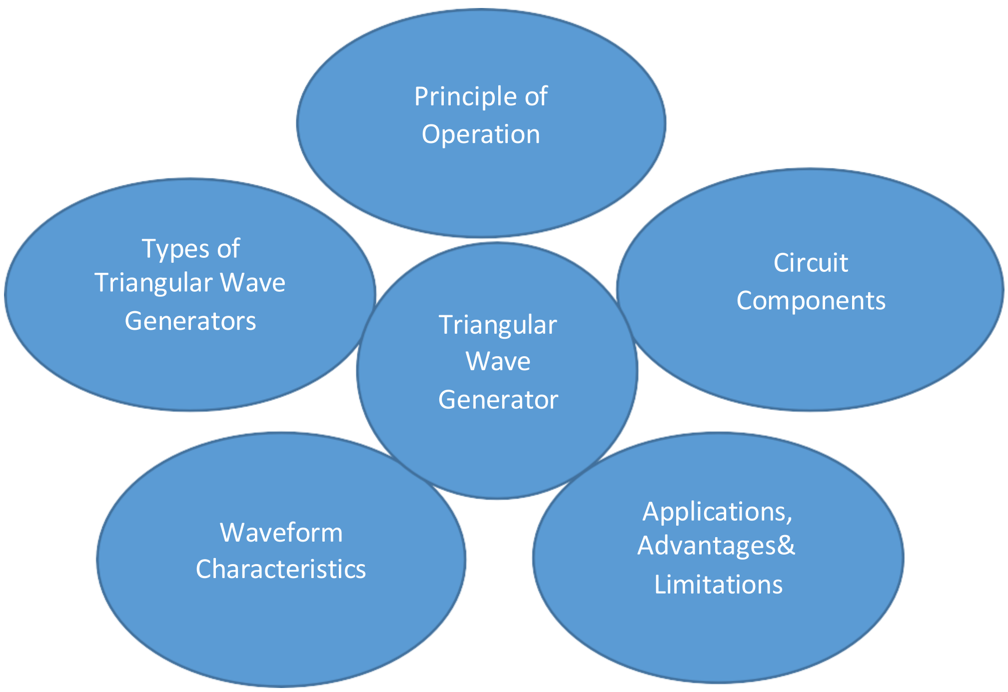
KeyWords:

Triangular waveform,Linear ramp,Oscillator,Integrator,Comparator,Square wave input,Slew rate, Duty cycle, Frequency control,Amplitude control, Op-amp, Wave shaping, Signal processing, Harmonic content, Function generator

KeyDiagram:



Mind Map:



Assessment Questions

1. Derive the expression for the frequency of a triangular wave generator.
2. Explain the function of a comparator in a triangular wavegenerator circuit.
3. Discuss the applications of triangular wavegenerators in electronics.
4. What are the limitations of a basic op-amp-based triangular wave generator?

References:

1. Kakani SK,Bhandari KC,Electronics Theory and Applications.NewDelhi:New Age International Publishers. Reprint. 2014
2. Thomas L.Floyd.Electronic Devices conventional currentversion.Pearson India Education Services Pvt.Ltd. 9th Edition 2020.
3. Jacob Milman and Christos C.Halkias.Integrated Electronics.India:TataMcGraw Hill. 2nd Edition1991.
4. Donald P. Leach, Albert Paul Malvino and Goutam Saha. Digital Principles and Applications.NewDelhi:The Mc GRAW-Hill Publishing Company Ltd.6th edition 2008

Verified by Subject Expert:

R. Monica

Course In-charge

Padmavathi P

Approved by HoD

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

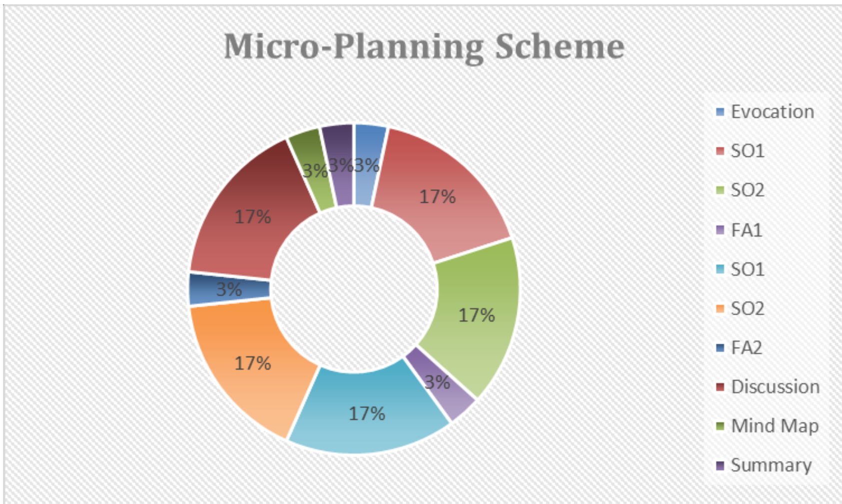
Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	I
Subject Title	Crystal growth & Thin films
Code	21PPHE11
Hours	6
Total Hours	90
Credits	4
Max Marks	100
Unit & Title	Unit IV: Thin Films
Name of the Faculty	Dr. A Nirmala Shirley
T-L tools	Lecture method, Visual aids: PPT, animations, Demonstration: Soap bubble interference, thin oil film on water, Experimental apparatus for observing interference and reflection.

Prerequisite Knowledge:

Knowledge of the wave nature of light, interference, and basic concepts of refraction and reflection.

Micro-Planning:



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. Topic for Learning Through Evocation:

Introduce thin films by discussing everyday phenomena such as

- The colourful patterns seen on soap bubbles or oil films.
- The significance of thin films in technology (anti-reflective coatings, lenses).

Ask students to recall interference and explain how light waves superimpose to create constructive and destructive interference.

2. Topic Introduction:

1. Definition: Thin films are layers of material ranging from fractions of a nanometre to micrometres in thickness.
2. Physics behind the colours: Thin-film interference due to phase difference in reflected light waves.
3. Types of Thin Films:
    - Uniform thin films
    - Non-uniform thin films

3. Objectives:

3.1 General Objective:

Enable students to understand the formation of interference patterns in thin films and their practical applications.

3.2 Specific Objectives:

1. Explain the basic principles of thin-film interference.
2. Derive the condition for constructive and destructive interference in thin films.
3. Analyze the phase change upon reflection in different media.
4. Discuss applications of thin films in optics and engineering.

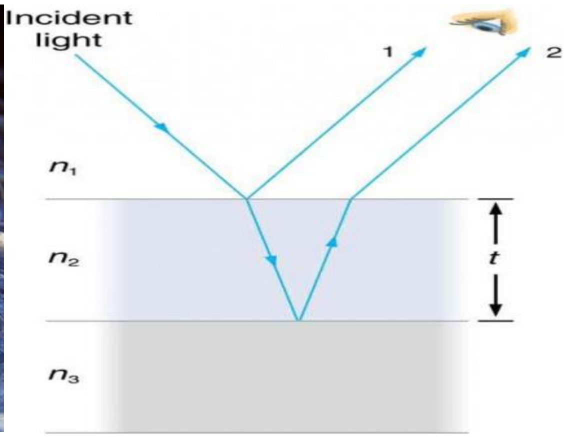
3.3 Taxonomy of Objectives:

Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

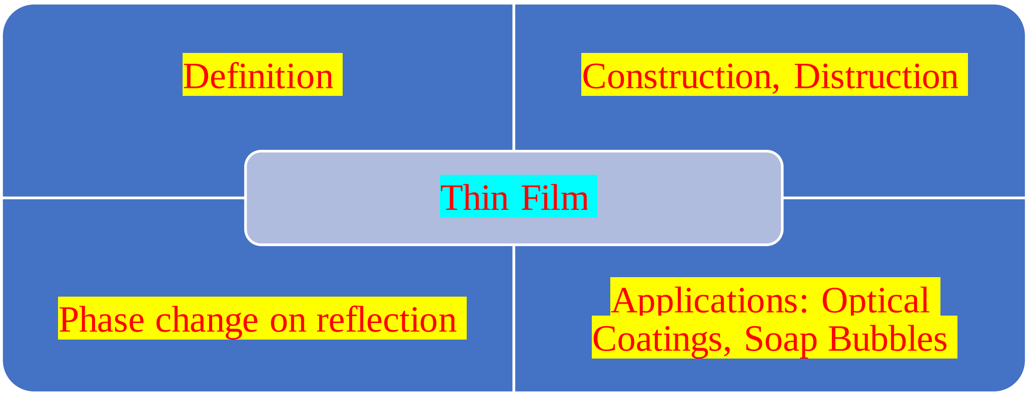
3.4 Key Words:

Thin film, interference, constructive interference, destructive interference, phase difference, optical path difference.

3.5. Key Diagrams:



4. Mind Map:



5. Summary:

Students will understand how interference patterns in thin films arise due to the wave nature of light. Emphasis will be placed on the phase difference, the conditions for interference, and real-world applications.

6. Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts:

- Discuss why a soap bubble appears colourful under sunlight.
- Analyze why anti-reflective coatings on glasses reduce glare.

7. FAQs:

1. What is the condition for constructive and destructive interference in thin films?
2. Explain the role of phase change in thin-film interference.
3. Why do thin films produce vibrant colours, but thicker films do not?
4. What are some practical applications of thin films in optics?

8. References:

1. Goswami A. *Thin film fundamental.* New Delhi: New age international (P) Ltd. 1st
2. Raghavan V. *Material science & Engineering – A first course.* 5th Edition 1974.Born, M., & Wolf, E. (2013). *Principles of Optics*. Pergamon Press.
3. Rajendran V. *Material Science.* New Delhi: Mcgraw hill. 1st reprint 2012.

9. Verified by Subject Expert:

A. Nirmala Shirley

Course In-charge

Padmavathi S P

Approved by HoD

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	II
Subject Title	Mathematical physics II
Code	21PPHC21
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit & Title	Unit II: Tensors
Name of the Faculty	Ms. P.Padmavathi
T-L tools	Lecture method Visual aids: PPT, animations, Demonstration: Examples of tensors in Physics (stress,strain,and moment of inertia tensor)

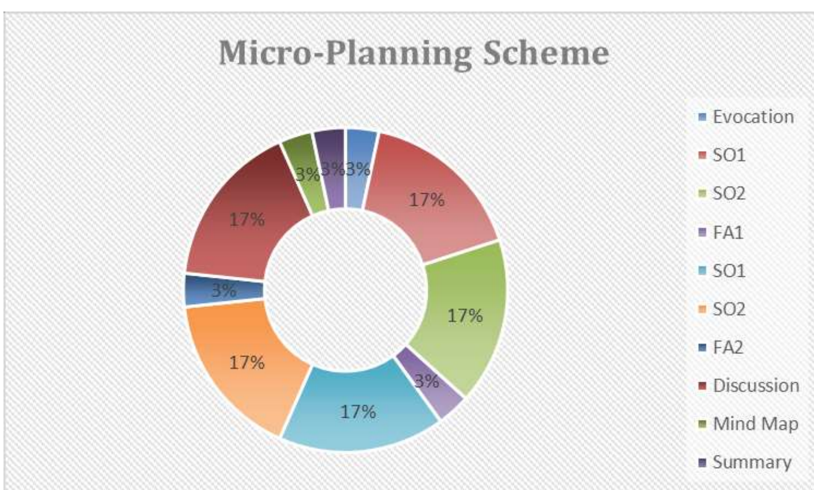
Prerequisite Knowledge:

Basic knowledge of vectors and matrices

Understanding of coordinate systems and transformations

Familiarity with linear algebra and differential equations

Micro-Planning:



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. Topic for Learning Through Evocation

Introduction to tensors through real-world examples:

Stress and strain in materials

Gravitational field tensors in general relativity

Moment of inertia tensor in rotational dynamics

Encouraging students to recall vector and matrix operations and relate them to tensors

2. Topic Introduction:

1.Definition: A tensor is a mathematical object that generalizes scalars, vectors, and matrices and is used to describe physical properties that are independent of coordinate systems.

2. Types of Tensors:

Scalar (0th-order tensor)

Vector (1st-order tensor)

Second-order and higher-order tensors

3. Tensor Notation & Representation

Contravariant and covariant tensors

Tensor rank and order

3. Objectives:

3.1 General Objectives:

Enable students to understand the concept of tensors and their applications in physics and engineering.

3.2 Specific Objectives:

1. Define tensors and explain their significance in physics.
2. Perform tensor operations such as addition, subtraction, and outer product.
3. Differentiate between symmetric and antisymmetric tensors.
4. Explain the applications of tensors in mechanics, electromagnetism, and general relativity.

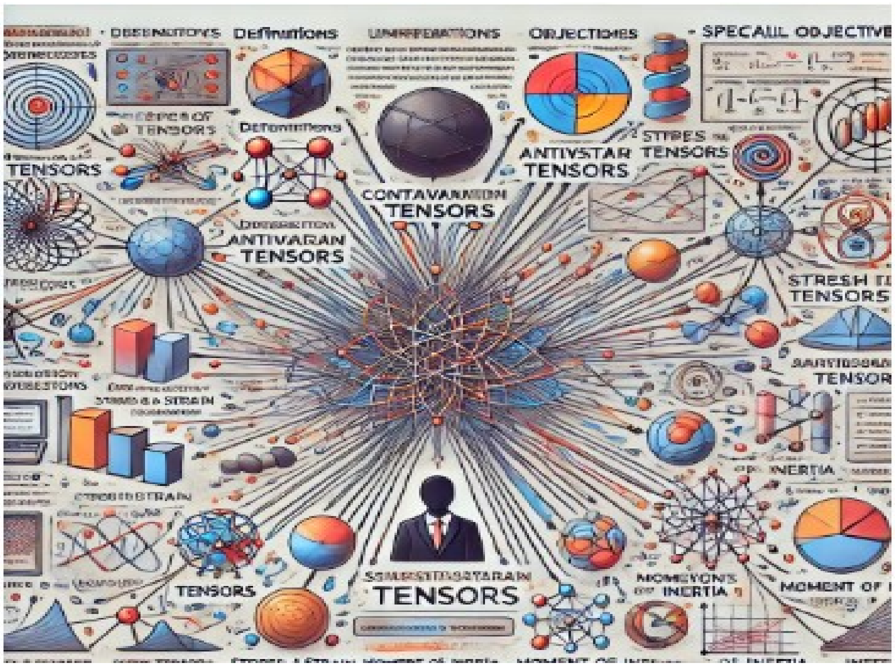
3.3 Taxonomy of Objectives:

Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

3.4 Key Words:

Tensor, contravariant vector, covariant vector, symmetric tensor, metric tensor, moment of inertia tensor**.**

4. Mind map



5. Summary:

Students will gain an in-depth understanding of tensors, their mathematical properties, and their significance in various fields of physics. The lesson will emphasize different types of tensors and their real-world applications in mechanics, electromagnetism, and relativity.

6. Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts

Why is a tensor considered a generalization of vectors and matrices?

How do tensors help describe stress and strain in materials?

What role do tensors play in Einstein's General Theory of Relativity?

7. FAQs:

1. What is the difference between a vector and a tensor?

2. How do you determine whether a tensor is symmetric or antisymmetric?

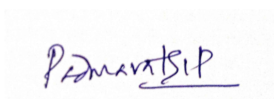
3. Why are tensors essential in theoretical physics?

4. What are the practical applications of tensors in physics and engineering**?**

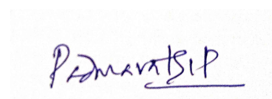
8.References:

1. Joshi A. W. Matrices and Tensors in Physics. New Age International Publishers, 3rd Edition, 2010.
2. Satya Prakash. Mathematical Physics. Sultan Chand & Sons, 4th Edition, 2004.
3. Singaravelu A. Numerical Methods. Meenakshi Agency, 2nd Edition, 2011.

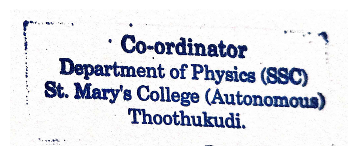
9. Verified by Subject Expert:



Course In-charge



Approved by HoD



<u>LESSON PLAN</u>

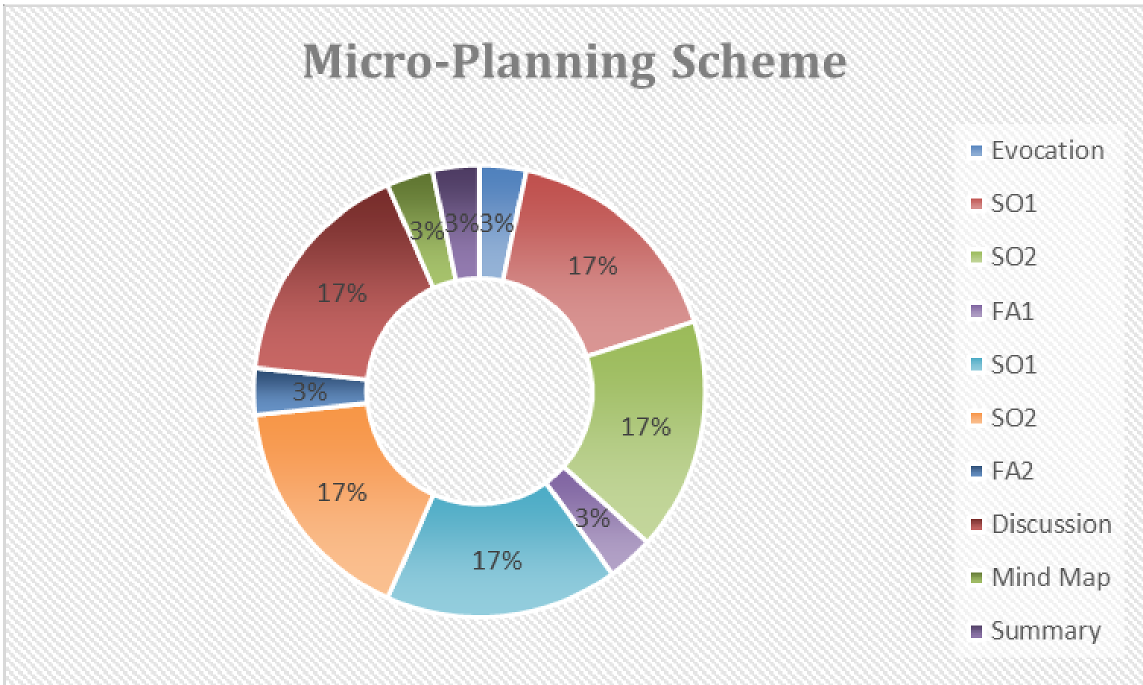
<u>Objective Oriented Learning Process RBT</u>

Programme	M.Sc Physics
Semester	II
Subject Title	Electromagnetic Theory
Code	21PPHC22
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit & Title	Unit I: Gauss Law
Name of the Faculty	Dr. A Nirmala Shirley
T-L tools	Lecture method, Visual aid: PPT, simulations, animations of flux and electric field Whiteboard for derivations and diagrams

Prerequisite Knowledge:

Basic understanding of electric field, electric flux, and the concept of charge distribution.

Micro-Planning:



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. **Topic for Learning Through Evocation:**

   Introduce the significance of Gauss's Law:

   Its role in simplifying the calculation of electric fields.

   Practical examples like symmetrical charge distributions (spherical, cylindrical).

   Historical context: Carl Friedrich Gauss and his contributions to mathematics and physics.

   Ask students to recall Coulomb's Law and discuss the concept of electric flux qualitatively.

2. Topic Introduction:

Statement of Gauss's Law:

"The net electric flux through any closed surface is equal to q_{enc}/ε_0 the total charge enclosed within the surface."

1. Explanation of terms like flux, Gaussian surface, and permittivity of free space.
2. Importance in simplifying field calculations for symmetric charge distributions.

3. Objectives:

3.1 General Objective:

Enable students to understand and apply Gauss's Law to determine electric fields in various scenarios.

3.2 Specific Objectives:

1. Describe the concept of electric flux and Gaussian surfaces.
2. State and explain Gauss's Law mathematically and conceptually.
3. Solve problems using Gauss's Law for symmetrical charge distributions.
4. Analyze the limitations and conditions for the applicability of Gauss's Law.

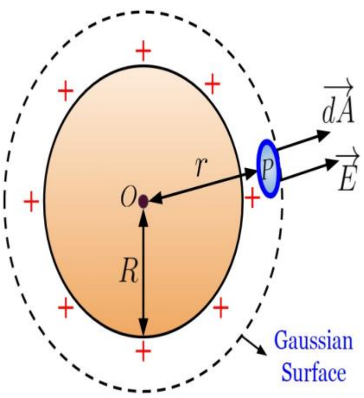
3.3 Taxonomy of Objectives:

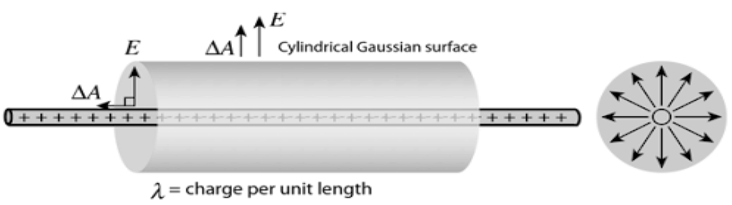
Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**		
Meta-Cognitive					**5**	**6**

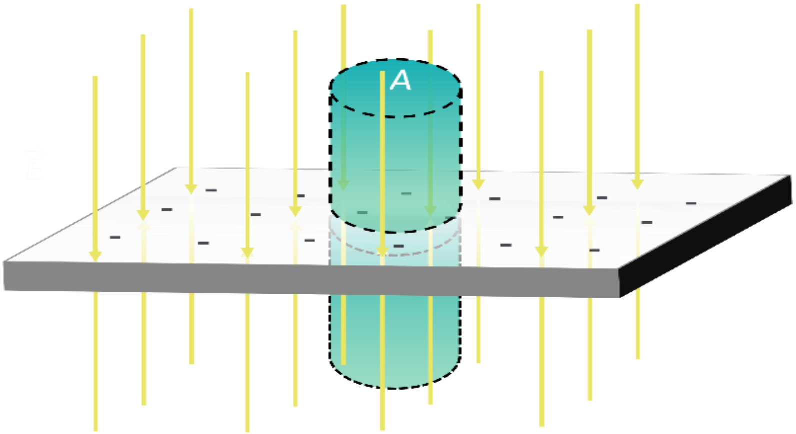
3.4 Key Words:

Electric flux, Gaussian surface, symmetrical charge distribution, enclosed charge, permittivity.

3.5. Key Diagrams:







4.Mind Map:

- Gauss's Law
- Definition & Formula
- Applications: Sphere, Cylinder, Plane
- Conditions for use
- Limitations

5. **Summary:**
Students will explain the derivation of Gauss's Law and its application to symmetric charge distributions using diagrams and examples.

6. **Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts:**
Discussing real-world scenarios where Gauss's Law simplifies electric field calculations (e.g., capacitors, charge on conductors).
Encourage students to visualize electric flux through a 3D simulation.

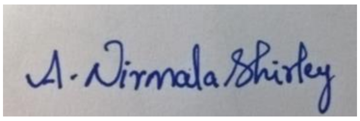
7. FAQs:

1. State Gauss's Law and explain its terms.
2. What is the electric field outside a uniformly charged spherical shell? Why?
3. For which charge distribution is Gauss's Law most useful?
4. Why is the Gaussian surface chosen based on symmetry?

8. References:

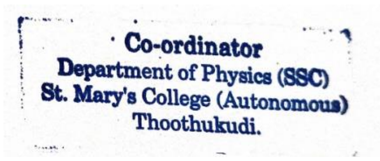
1. Griffiths, D. J. (2017). *Introduction to Electrodynamics*. Cambridge University Press.
2. Purcell, E. M., & Morin, D. J. (2013). *Electricity and Magnetism*. Cambridge University Press.
3. Serway, R. A., & Jewett, J. W. (2018). *Physics for Scientists and Engineers with Modern Physics*. Cengage Learning.

9. Verified by Subject Expert:



Course In-charge

Approved by HoD



LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	II
Subject Title	Thermodynamics and Staistical Mechanics
Code	21PPHC23
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit &Title	Unit II:Thermodynamics of magnetism–Blackbody radiation
Name of the Faculty	Mrs.Y.Sasikala
T-L tools	Lecture method,Visual aids:PPT, animations

Pre requisite Knowledge:

To study black body radiation, the following pre requisites are essential:

- Basic Thermodynamics: Understanding thermal equilibrium and heat transfer.
- Electromagnetic Radiation: Familiarity with wavelengths and frequencies.
- Planck's Law: Knowledge of how temperature affects radiation intensity.
- Wien’s Displacement Law:Understanding the relationship between temperature and peak wavelength.
- Stefan-Boltzmann Law: Familiarity with energy emission proportional to the fourth power of temperature.

Micro-Planning:

Activity	Duration	Purpose
Evocation	5min	Generate interest in blackbody radiation through engaging questions or real-world examples.
Objective Presentation	5min	Present learning goals.Understand the concept of black body radiation.
Explanation	20min	Define a blackbody and its ideal characteristics. Explain Planck's law: how temperature affects the intensity and distribution of emitted radiation. Describe Wien’s displacement law: the Relationship between temperature and peak wavelength of emitted radiation.
Demonstration	10min	Visualize blackbody radiation behavior. Use simulations or videos to show how Objects emit radiation at different temperatures.
Assessment and Discussion	10min	Evaluate comprehension through Q&A. Encourage them to solve problems related to calculating wavelengths or energy emissions based on given temperatures.
Summary	10min	Define blackbody radiation and its significance in physics. Highlight key laws: Planck's law, Wien’s displacement law, and Stefan-Boltzmann law. Discuss real-world applications, such as in astrophysics, thermal imaging and climate science.

1. **Evocation(5 min)**
    - Purpose: Generate interest in blackbody radiation through engaging questions or real-world examples.
    - Ask questions like:
    - "Why do heated objects change color,like a metal turning red when heated?"
    - "How does the temperature of a star affect its color and brightness?"
    - Use visuals, such as images of stars or thermal radiation graphs, to spark curiosity.

2. Objective Presentation(5min)

- Purpose : Present learning goals.
- Understand the concept of black body radiation.
- Learn about Planck's law and its implications for emitted radiation.
- Explore Wien’s displacement law and the Stefan-Boltzmann law.

3. **Explanation** (20min)

- Purpose: Discuss theoretical concepts.
- Define a blackbody and its ideal characteristics.
- Explain Planck'slaw: how temperature affects the intensity and distribution of emitted radiation.
- Describe Wien’s displacement law:the relationship between temperature and peak wavelength of emitted radiation.
- Discuss the Stefan-Boltzmann law:total energy emitted per unit area as a function of temperature.

4. Demonstration(10min)

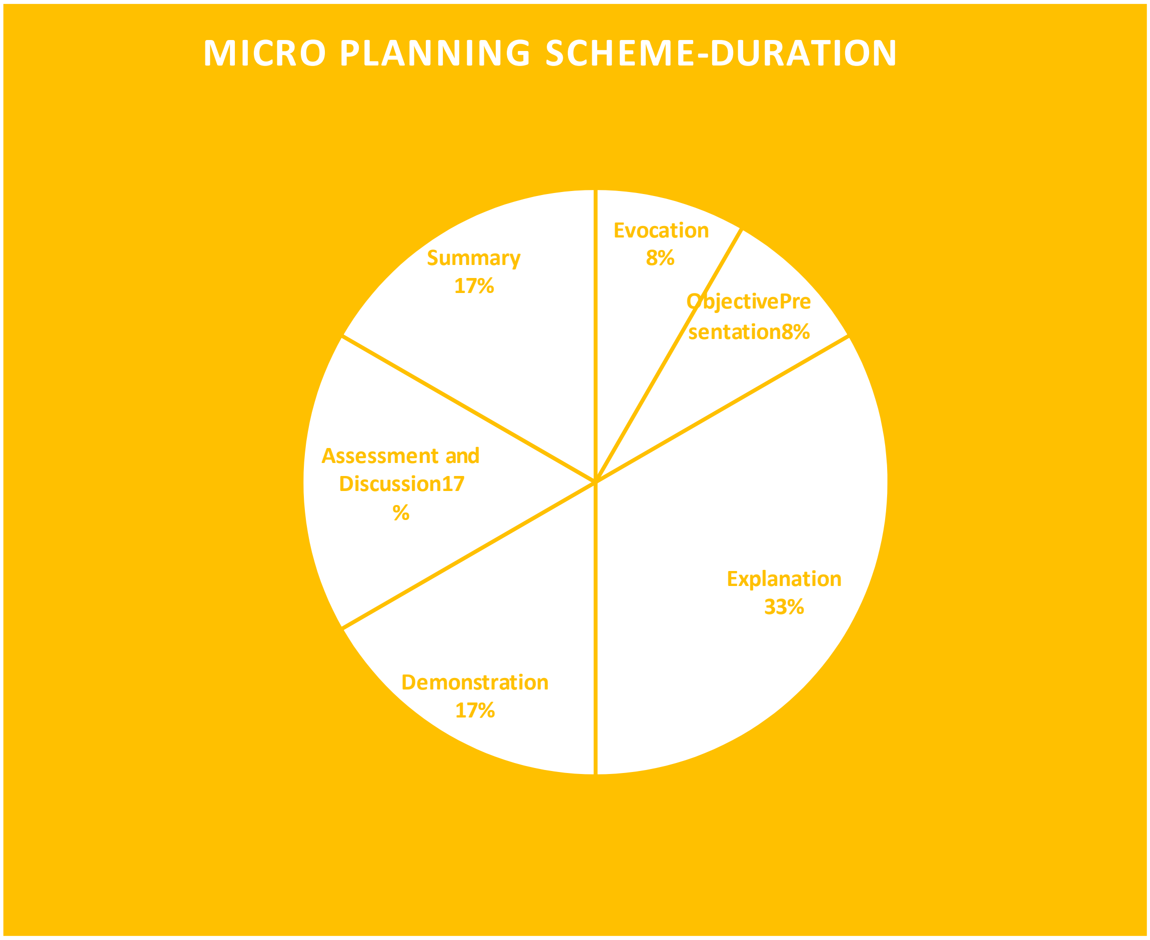
- Purpose: Visualize blackbody radiation behavior.
- Use simulations or videos to show how objects emit radiation at different temperatures.
- Demonstrate the color change of heated objects and how it relates to temperature.

5. Assessment and Discussion(10min)

- Purpose: Evaluate comprehension throughQ&A.
- Ask students to explain concepts like Planck'slaw and Wien’s displacement law in their own words.
- Encourage them to solve problems related to calculating wavelengths or energy emissions based on given temperatures.

6. Summary(10min)

- Purpose: Recap keypoints discussed during the session.
- Define blackbody radiation and its significance in physics.
- Highlight key laws: Planck's law,Wien’s displacement law and Stefan-Boltzmann law.
- Discuss real-world applications,such as in astrophysics,thermal imaging andclimate science.



General Objective:

- Understand Fundamental Concepts: Grasp the principles and significance of black body radiation.
- Explore Key Laws: Learn about Planck's law,Wien’s displacement law and the Stefan-Boltzmann law.
- Apply Knowledge: Investigate real-world applications in astrophysics and climate science.

Specific Objectives:

- Analyze Emission Spectra: Investigate how temperature affects the intensity and distribution of radiation using Planck's law.
- Apply Wien’s Displacement Law: Determine the peak wavelength of emitted radiation at various temperatures.
- Utilize the Stefan-Boltzmann Law:Calculate the total energy radiated by a blackbody per unit area based on its temperature.

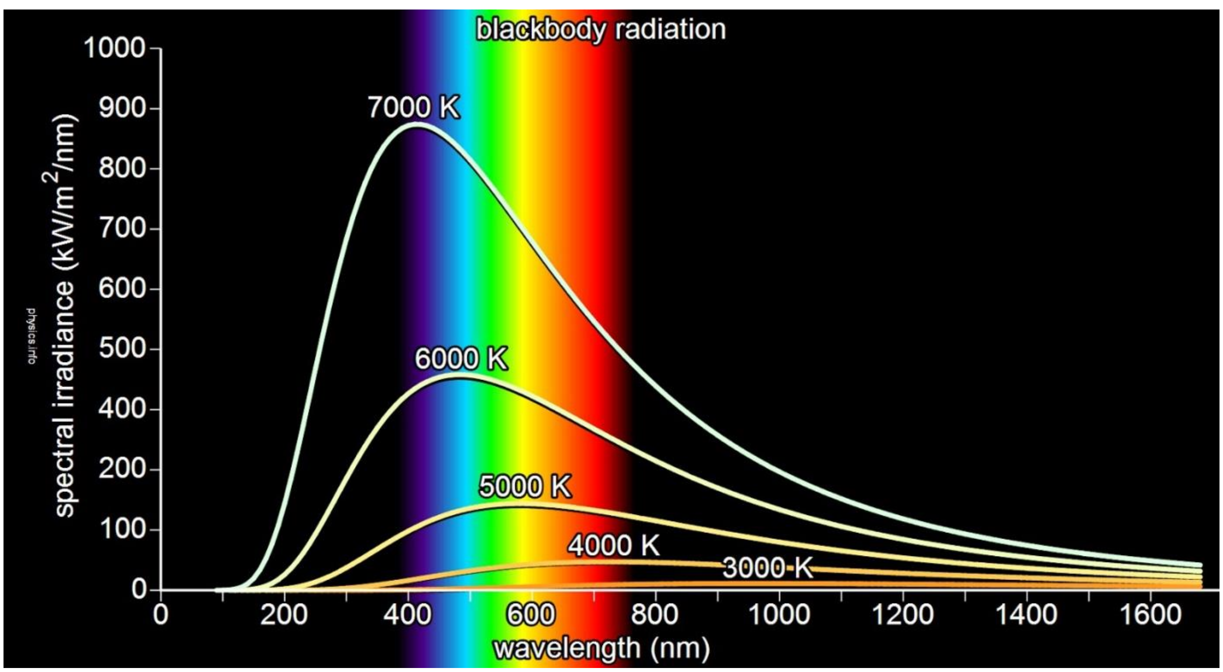
Taxonomy of Objectives:

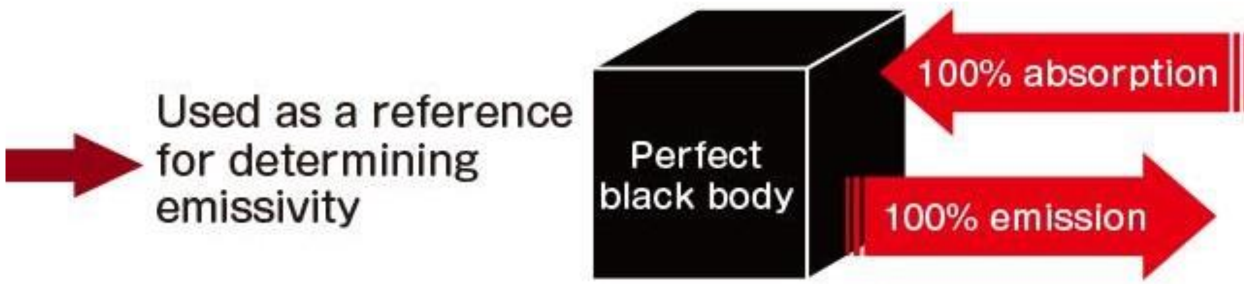
Taxonomy of Objectives						
Knowledge Dimension	**CognitiveProcessDimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

KeyWords:

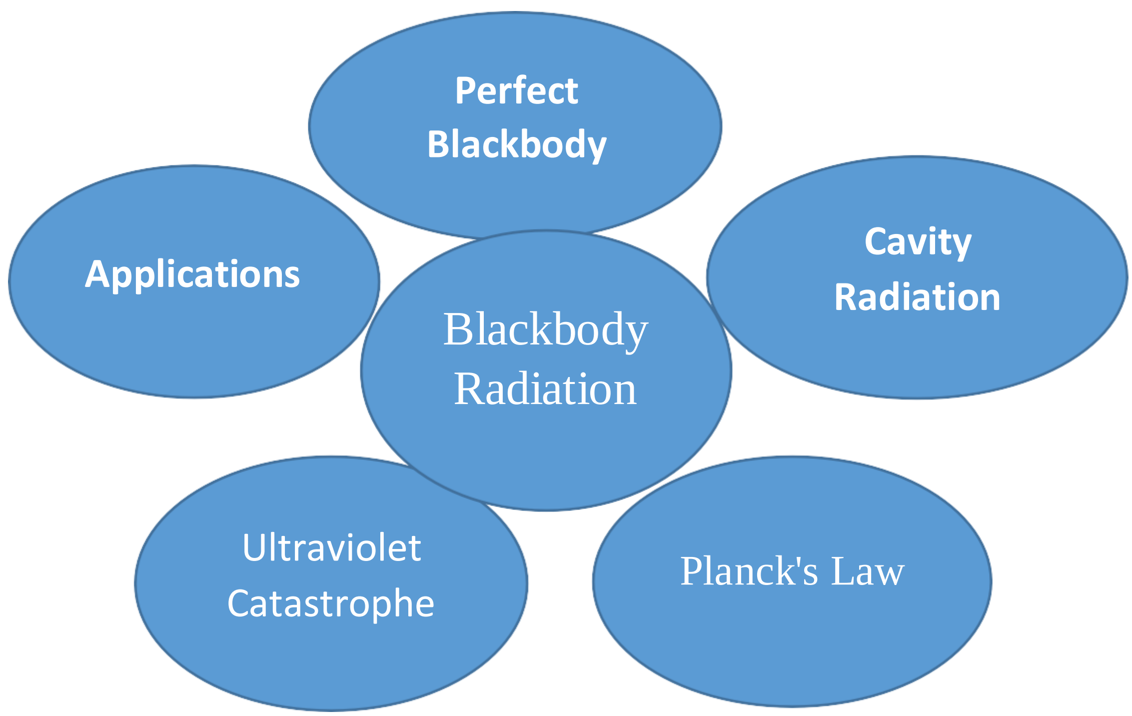
Blackbody Radiation,Temperature Dependence, Planck's Law, Stefan-Boltzmann Law, Applications, Ultraviolet Catastrophe, Real-World Examples

Key Diagram:





Mind Map:



Assessment Questions

1. Why do hotter objects emit radiation with shorter wavelengths?
2. How does black body radiation provide evidence for quantization of energy?
3. Compare the black body radiation curves of two objects at different temperatures and explain the differences.
4. Why do stars of different temperatures appear in different colors?
5. How is the concept of blackbody radiation applied in modern technology, such as infrared thermography and astronomy?

References:

1. Dass VN. Heat and thermodynamic.Delhi:Dominant Publishers.1stEdition2005.
2. Gupta MC.Statistical Thermodynamics.NewDelhi: New Age International PLtd. Reprint 2009.
3. Sears Salinger.Thermodynamics,Kinetic Theory and Statistical Thermodynamcis. New Delhi: Narosa publishing house pvt Ltd.3rd Edition 2017.
4. Agarwal BK, Melvin Eisner. Statistical Mechanic.NewDelhi:New age international P Ltd. Reprint 2002.

Verified by Subject Expert:

Course In-charge **Approved by HoD**

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	II
Subject Title	Microprocessor and Microcontroller
Code	21PPHE22
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit & Title	Unit V: Addressing Modes and Delay
Name of the Faculty	Ms. S.Saravana Selvi
T-L tools	Lecture method Visual aids: PPT, animations, Problem-solving Sessions.

Prerequisite Knowledge:

Before learning this unit, students should be familiar with:

Basics of 8085 and 8051 architecture.

Fundamentals of assembly language programming.

Concept of memory addressing and instruction execution.

Logic operations and program flow control techniques.

Micro-Planning:

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. Topic for Learning Through Evocation

1.T o understand different addressing modes used in the 8051 microcontroller.

2. To learn how time delay functions are implemented in assembly language.

3. To develop skills in writing assembly language programs using addressing modes.

4. To analyze the impact of addressing techniques on performance and execution speed.

2. Topic Introduction

1. Introduction to Addressing Modes

Definition and significance of addressing modes in microprocessors and microcontrollers.

Importance of efficient memory addressing in embedded systems.

Overview of 8051 microcontroller addressing techniques.

2. Types of Addressing Modes (2 Hours)

Register Addressing Mode – Accessing data directly from registers.

Direct Addressing Mode – Direct access of memory locations using fixed addresses.

Register Indirect Addressing Mode – Using register pairs for accessing memory locations.

Immediate Addressing Mode – Using constant values within the instruction.

Indexed Addressing Mode – Utilizing program counters and index registers.

Practical examples demonstrating the use of each addressing mode

3. Time Delay Techniques in 8051 (1 Hour)

Concept of time delay in microcontroller programming.

Creting delays using loops and timers.

Using NOP (No Operation) instructions for precise microsecond delays.

4. Assembly Language Programming for Addressing Modes & Delays (1 Hour)

Writing basic assembly programs utilizing different addressing modes.

Implementing a time delay routine using an 8051 assembly language.

Testing and debugging delay-based programs.

5. Practical Applications & Case Study (1 Hour)

Interfacing LED Blinking Program – Using different addressing modes.

Keypad Scanning using Addressing Modes – Input interfacing example.

Delay Generation for Serial Communication – UART delay case study.

3. Objectives:

3.1 General Objectives:

By the end of this unit, students should be able to Understand different addressing modes in microcontrollers..

3.2 Specific Objectives:

1. Implement register, direct, indirect, and immediate addressing in assembly language.

2.Explore delay techniques using loops, timers, and NOP instructions.

3.Apply addressing modes and delays in real-time embedded applications.

4.Write assembly language programs for time delays in 8051 microcontrollers.

3.3 Taxonomy of Objectives:

Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

3.4 Key Words:

Addressing Modes, Register Addressing, Direct & Indirect Addressing, Immediate & Indexed Addressing, Time Delay Techniques, NOP Instruction and Assembly Programming

4. Mind map

5. Summary:

This unit covers different addressing modes in microprocessors and microcontrollers along with time delay techniques. It explores practical implementation in 8051 microcontrollers using assembly language programming. Students will understand how to optimize time delays using loops, timers, and NOP instructions, which is crucial for embedded system applications.

6. Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts

1. Define addressing modes and explain their types with examples

2. How does immediate addressing differ from register addressing?

3. Write an assembly program to implement a time delay using a loop.

4. What is the role of the NOP instruction in time delay programming?

5. Explain the importance of indexed addressing in 8051?

7. FAQs:

1. Why do we need different addressing modes?

2. Which addressing mode is fastest?

3. What is the difference between loop-based and timer-based delay?

4. How can we optimize delay routines?

5. Can we implement delays without loops?

8. References:

1. Ramesh Gaonkar, Microprocessor Architecture Programming and Applications with The 8085, Penram International Publishing, 5th Edition, 2011.

2. Karuna Sagar D, Microcontroller, 8051, Narosha Publishing House, 2011.

3. Dr. Godse A. P., Microprocessor and Microcontroller, Technical Publications, 4th Revised Edition, 2017.

9. Verified by Subject Expert:

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

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	III
Subject Title	Quantum Mechanics I
Code	21PPHC31
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit & Title	Unit II-Operators
Name of the Faculty	Ms. S. Saravana Selvi
T-L tools	Lecture method ,Visual aids, PPT, animations, Problem-solving sessions, Derivation –based learning

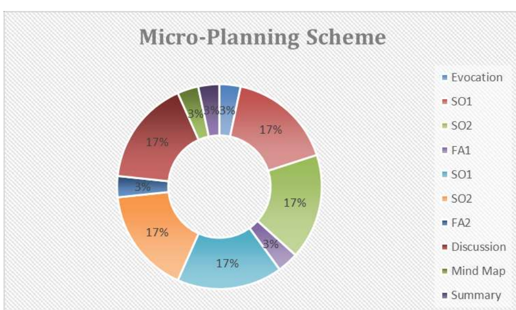
Prerequisite Knowledge:

Basic knowledge of linear algebra

Concepts of vector spaces and matrices

Fundamental principles of quantum mechanics

Micro-Planning:



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. Topic for Learning Through Evocation

Real-world analogies of operators:

Example: Rotation operator in geometry (rotating vectors in 2D space).

Example: The role of Hermitian operators in measuring physical observables.

Discuss applications of operators in quantum mechanics:

Position and momentum operators

Energy (Hamiltonian) operator in Schrödinger's equation

2. Topic Introduction

1. Definition: Operators in quantum mechanics act on wave functions to produce measurable quantities.

2. Hilbert Space: The mathematical framework for quantum states, consisting of vectors and inner products.

3. Dirac Notation (Bra-Ket Notation): A convenient way to represent quantum states.

4. Types of Operators:

Linear Operators (additivity and scalar multiplication)

Hermitian Operators (real eigenvalues, measurable quantities)

Unitary Operators (preserve norms, quantum evolution)

Projection Operators (probabilistic interpretation)

Parity Operators (reflection symmetry)

3. Objectives

3.1 General Objective

Enable students to understand the significance of quantum operators and their role in mathematical and physical interpretations.

3.2 Specific Objectives

1. Explain Hilbert space and vector space representations in quantum mechanics.

2. Define and use Bra & Ket notation in quantum calculations.

3. Differentiate between different types of operators and their properties.

4. Understand how operators act on wave functions in discrete and continuous bases.

5. Solve quantum mechanics problems involving operators and their representations.

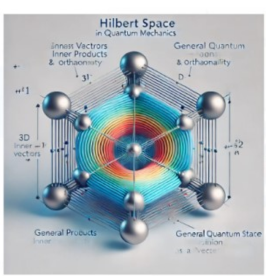
3.3Taxonomy of Objectives:

Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

3.4 Key Words:

Hilbert space, linear operator, Hermitian operator, unitary operator, projection operator, Dirac notation, position and momentum representation.

4. Mind map



5. Summary:

Students will gain a clear understanding of operators in quantum mechanics, including their mathematical representation, physical significance, and role in solving quantum problems. The lesson will focus on the application of these operators in various quantum systems.

6. Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts

1. What is the significance of a Hermitian operator in quantum mechanics?

2. Why are unitary operators important in quantum evolution?

3. How do projection operators help in probability measurements?

4. Give an example where the parity operator plays a key role in quantum physics.

7. FAQs:

1. What is the difference between Hermitian and unitary operators?

2. How does Dirac notation simplify quantum mechanical calculations?

3. Why must quantum observables be represented by Hermitian operators?

4. How do operators relate to eigenvalues and eigenfunctions in quantum mechanics?

8. References:

1. Mathews P.M and Venkatesan K. *A Text Book of Quantum Mechanics*. NewDelhi: Tata McGraw Hill Publishing Company Limited. 16th reprint ,second edition.2007
2. Shankar R. *Principles of Quantum Mechanics.* New York: Plenum Publishers. SecondEdition 1994.
3. Sakurai J J. *Modern Quantum Mechanics.* Addison- Wesley Publishing Company.Revised edition 1994.
4. Rajasekar S and Velusamy R. *Quantum Mechanics I: Fundamentals.* London: CRCPress. Taylor and Francis group- Boca Raton. e-book version 2015.

9. Verified by Subject Expert:

Course In-charge **Approved by HoD**

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

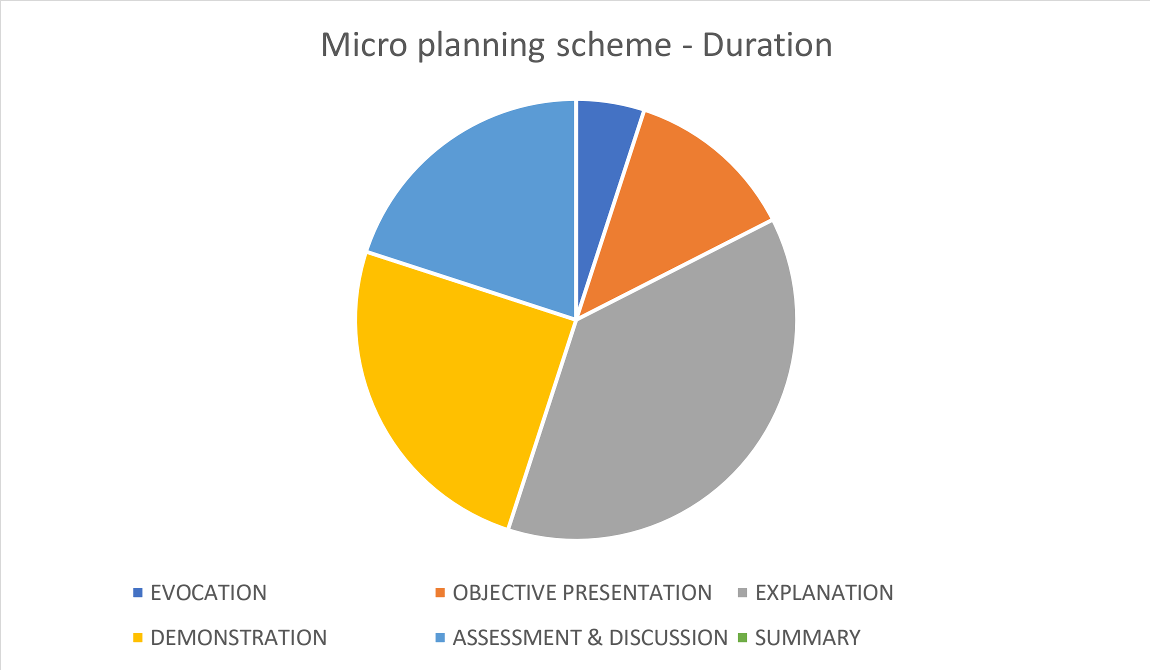
Programme	M. Sc Physics
Semester	III
CourseTitle	Atomic and molecular Spectroscopy
Code	21PPHC32
Hours	6
TotalHours	90
Credits	5
MaxMarks	100
Unit &Title	UnitIII:The Diatomic vibrating rotator
Nameofthe Faculty	Mrs. P. Padmavathi
T-L tools	Lecture method, Spectroscopy experiments, Molecular simulation tools.

Prerequisite Knowledge:

- Basics of diatomic molecular bonds.
- Understanding of rotational and vibrational energy levels.
- Knowledge of quantum mechanical principles.

Micro-Planning: 60 minutes

Activity	Duration	Purpose
Evocation	2 min	To generate interest using real-world examples such as infrared spectroscopy applications in medical diagnostics
Objective Presentation	5 min	To state learning goals: Understand energy quantization in diatomic molecules
Explanation	15 min	To teach theoretical concepts of diatomic vibrating rotators
Demonstration	10 min	Use animations to visualize rotational and vibrational modes
Assessment and Discussion	8 min	To pose questions to gauge understanding
Summary	5 min	To recall key concepts



Learning Objectives:

General Objective:

- Enable students to comprehend the quantum-mechanical model of a diatomic vibrating rotator.

Specific Objectives:

- Derive the energy levels of a vibrating rotator using quantum mechanics.
- Explain the interplay between rotational and vibrational energy levels.
- Discuss the physical interpretation of the P, Q, and R branches in molecular spectroscopy.
- Apply concepts to interpret molecular spectra.

Key Topics:

- Energy Quantization in Vibrating Rotators:

Vibrational energy levels: $E_v = (\upsilon + \frac{1}{2})h\,\upsilon$

Rotational energy levels: $E_J = BJ(J+1)$

- Anharmonic Oscillations:

Explanation of anharmonic corrections.

- Spectroscopic Transitions:

Selection rules:

Δυ = ±1 for vibrational energy

ΔJ = ±1 for rotational energy

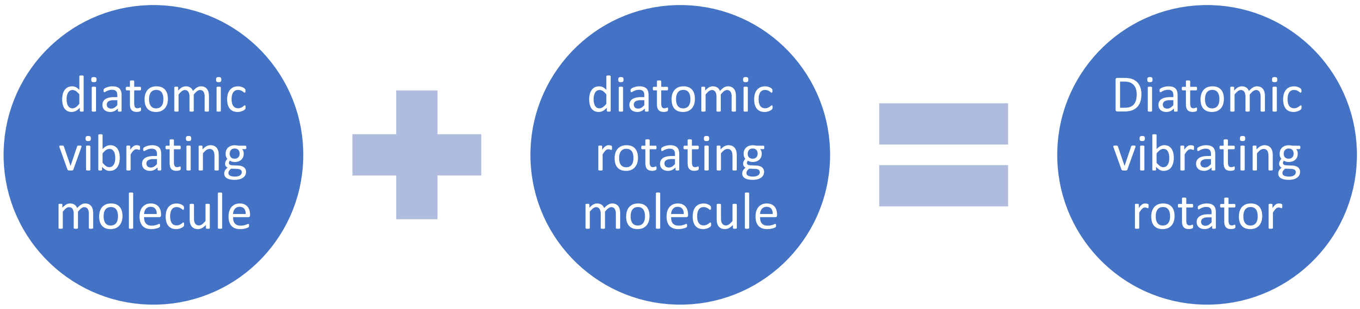
- Applications:

Infrared spectroscopy and molecular structure determination.

Taxonomy of Objectives:

Taxonomyof objectives						
KnowledgeDimension	**TheCognitiveProcess Dimension**					
	Remember	Understand	Apply	Analyze	Evaluate	**Create**
A.Factual Knowledge		1				
B.Conceptual Knowledge			2	2		
C.Procedural Knowledge				3	3	
D.Meta Cognitive Knowledge					4	

Mind Map



Summary:

- Vibrational and rotational energy levels in diatomic molecules are quantized.
- Transitions between these levels explain molecular spectra.
- Real-world applications include spectroscopy in chemistry and biology.

Assessment Questions:

1. Derive the total energy equation for a vibrating rotator.
2. Why do we observe P, Q, and R branches in a molecular spectrum?
3. Explain the significance of anharmonic corrections.
4. Discuss practical applications of this model in spectroscopy.

References:

1. Herzberg, G. Molecular Spectra and Molecular Structure.

2. Banwell, C. N., Fundamentals of Molecular Spectroscopy.

3. McQuarrie, D. A., Quantum Chemistry.

Verified by Subject Expert:

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

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	III
Subject Title	Solid State Physics I
Code	21PPHC33
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit &Title	Unit I :Bonding in Solids–Covalent Bond
Name of the Faculty	Mrs.Y.Sasikala
T-L tools	Lecture method,Visual aids:PPT, animations

Pre requisite Knowledge:

- Electron sharing between non metals.
- Similar electron negativity values among the atoms.
- A favourable valence electron configuration that allows for stable bonding.
- Consideration of molecular geometry for understanding molecular interactions.

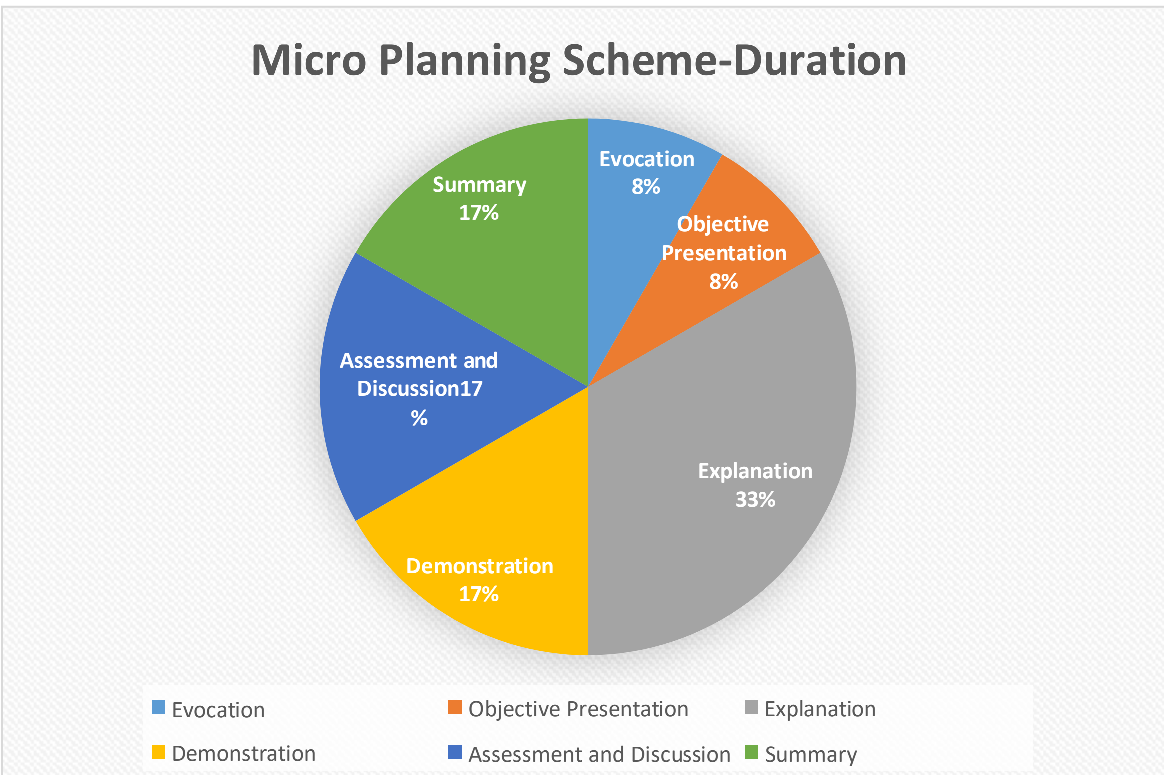
Micro-Planning:

Activity	Duration	Purpose
Evocation	**5min**	Generate interest in covalent bonding through engaging questions or real-world Examples (e.g.,water,organic compounds).
Objective Presentation	**5min**	Present learning goals:understanding Covalent bonds,their properties,and how they form.
Explanation	**20min**	Discuss theoretical concepts:electron sharing,valence electrons,the octetrule and types of covalent bonds (single,double, triple).
Demonstration	**10min**	Use molecular models or simulations to visualize covalent bonding and molecular geometry(e.g.,using software like PhET or physical models).
Assessment and Discussion	**10min**	Facilitate a Q&A session to evaluate comprehension; ask students to explain concepts in their own words or solve simple Problems related to covalent bonding.
Summary	**10min**	Recap keyfactors: definitions,types of covalent bonds, importance of electron Sharing and real-life applications.

1. Evocation(5min)
   - Start with intriguing questions such as:
   - "What makes water a liquid at room temperature?"
   - "Why do some gases like oxygen exist as O_2?"
   - Use visuals or anecdotes related to everyday life to spark interest.
2. Objective Presentation (5min)
   - Clearly outline the session's objectives:
   - Understand what covalent bonds are.
   - Learn how atoms share electrons.
   - Identify different types of covalent bonds and their properties.
3. Explanation(20 min)
   - Cover the following theoretical concepts:
   - Definition of covalent bonding.
   - Importance of valence electrons and the octet rule.
   - Types of covalent bonds:
   - Single bonds (e.g.,H_2), Double bonds (e.g.,O_2), Triple bonds(e.g.,N_2)

- Use diagrams and animations to enhance understanding.

4. Demonstration(10min)
   - Show a simulation or use molecular visualization tools that illustrate how atoms bond through shared electrons.
   - Demonstrate howchanging the number of shared electrons affects bond strength and molecular shape.
5. Assessment and Discussion(10min)
   - Engage students with questions such as:
   - "How does the sharing of electrons lead to stability?"
   - "Can you give examples of compounds with single, double, and triple bonds?"
   - Encourage peer-to-peer discussion to deepen understanding.
6. Summary (5min)
   - Recap the key points discussed during the session:
   - What covalent bonding is and why it's important.
   - The role of valence electrons in bond formation.
   - Real-world applications of covalent compounds in biology and chemistry..



General Objective:

Achieve atomic stability through electron sharing,understand molecular properties and interactions, and apply these principles in technology and materials science.

Specific Objectives:

- Understand Covalent Bonding: Grasp the concept that covalent bonding involves the sharing of electron pairs between nonmetal atoms to achieve stable electron configurations.
- Identify BondTypes:Differentiate between covalent bonds and other types of chemical bonds (ionic and metallic) and classify single, double, and triple covalent bonds.
- Apply Lewis Structures: Learn to draw Lewis structures to represent the arrangement of electrons in molecules accurately.
- Explore Real-World Applications:Understand the significance of covalent compounds in various fields, including chemistry, biology, and materials science, and their practical applications.

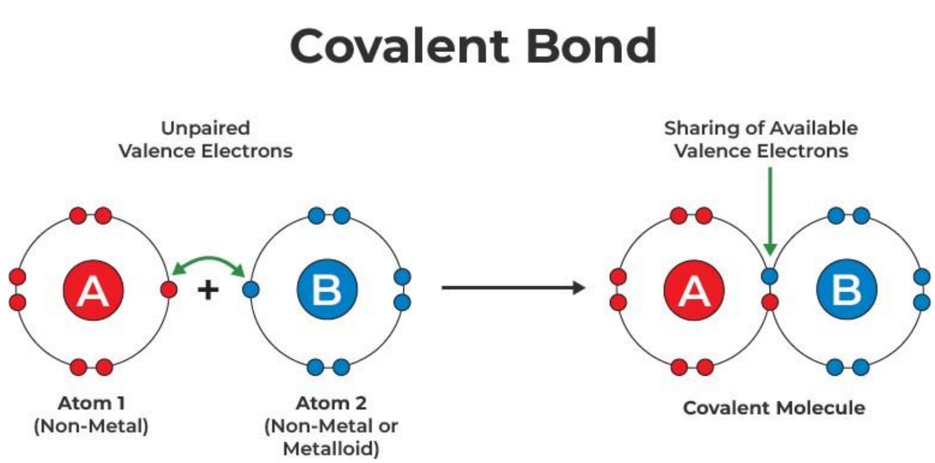
Taxonomy of Objectives:

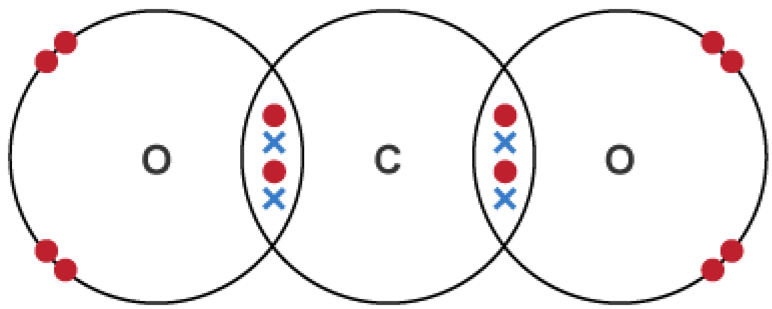
Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

KeyWords:

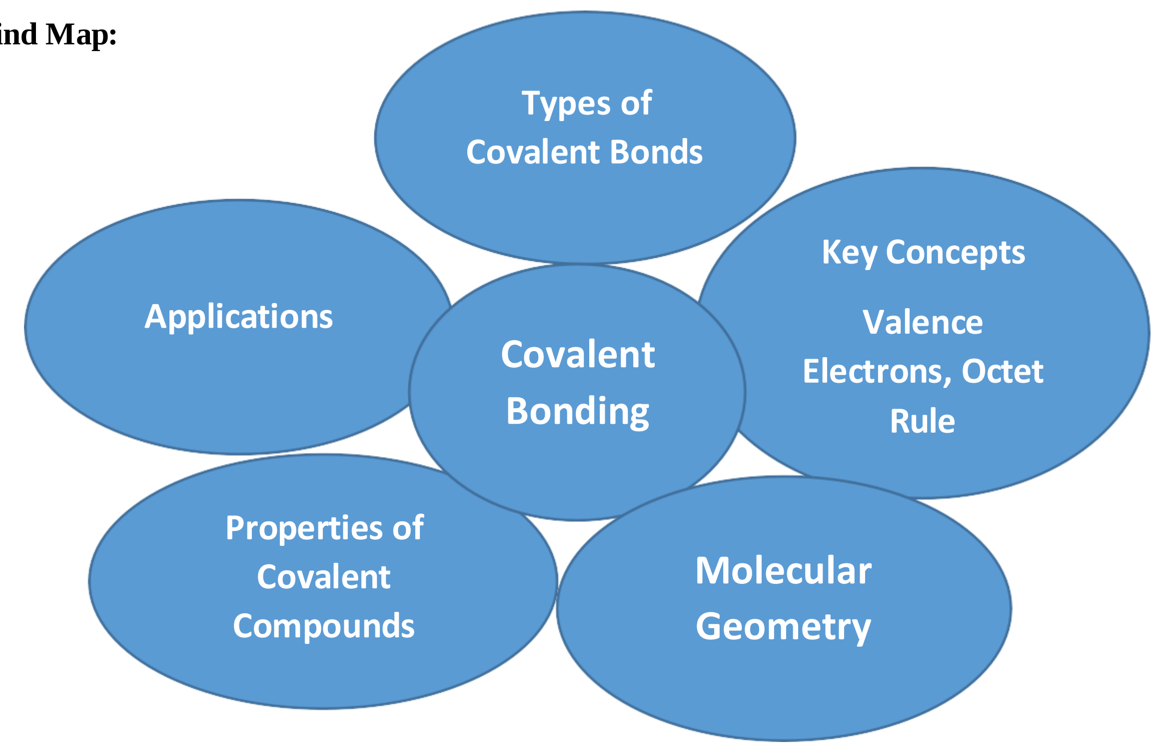
Valence electrons,octet rule, types of bonds (single,double,triple),polar/ nonpolar bonds

Key Diagram:





Mind Map:



Assessment Questions

1. Why do some covalent molecules exhibit **polarity**? Explain with an example.
2. Compare and contrast **covalent bonding** and **ionic bonding**.
3. Why does diamond have a higher hardness compared to graphite,eventhough both are made of carbon?
4. Explain the concept of **coordinate covalent bonding** with an example.

5. Predict whether **HCl** will have a polar or non-polar covalent bond and justify your answer.

References:

1. Pillai SO.Solid State Physics. New Age International(P)Limited. Reprint, 8th Edition 2018.
2. Charles Kittel.Introduction to Solid State Physics.Wiley Publications.Reprint2019.

Verified by Subject Expert:

Course In-charge **Approved by HoD**

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

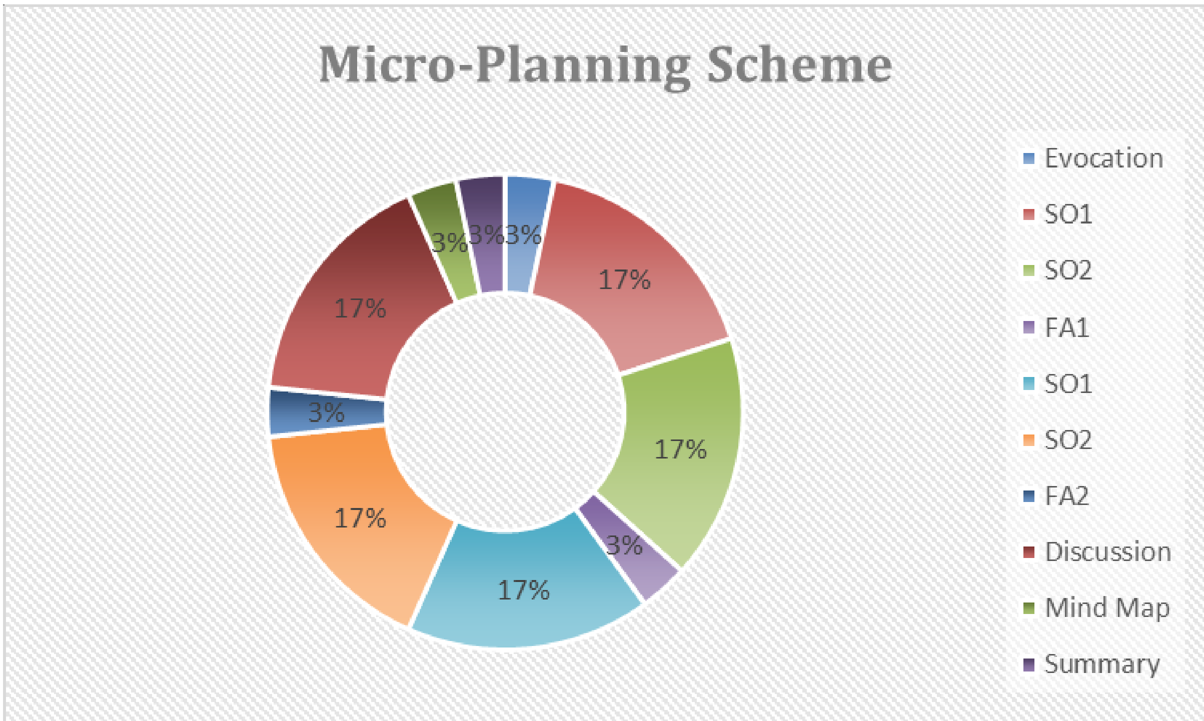
Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	III
Subject Title	Nano Science and Technology
Code	21PPHE31
Hours	6
Total Hours	90
Credits	4
Max Marks	100
Unit & Title	Unit I: Nano Structures
Name of the Faculty	Dr. A Nirmala Shirley
T-L tools	Lecture method, Visual aids: PPT, animations of nanostructure properties and behaviours Demonstration: Videos of nanostructure synthesis and applications

Prerequisite Knowledge:

Basic understanding of atomic structure, quantum mechanics, and solid-state physics.

Micro-Planning:



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. **Topic for Learning Through Evocation:**
   Introduce nanostructures by discussing their significance in modern science and technology:
   - Unique properties (e.g., optical, electrical, magnetic) that emerge at the nanoscale.
   - Everyday applications: Nanomedicine, nanoelectronics, and nanocomposites.

   Ask students to discuss how reducing the size of a material changes its physical properties, linking it to the concept of surface area to volume ratio.
2. **Topic Introduction**:
   - Definition: Nanostructures are materials with at least one dimension in the nanometer range (1–100 nm).
   - Types of Nanostructures:

     Zero-dimensional (nanoparticles)

     One-dimensional (nanowires, nanotubes)

     Two-dimensional (thin films, graphene)

     Three-dimensional (bulk nanostructured materials)
   - Properties of Nanostructures:
     Quantum confinement

     High surface-to-volume ratio

     Tunable optical and electronic properties

3. Objectives:

3.1 General Objective:

Enable students to understand the types, properties, and applications of nanostructures.

3.2 Specific Objectives:

1. Define nanostructures and describe their classification.

2. Explain how properties change at the nanoscale due to quantum effects and surface phenomena.

3. Describe methods for synthesizing nanostructures (top-down and bottom-up approaches).

4. Discuss the applications of nanostructures in various fields like medicine, electronics, and energy.

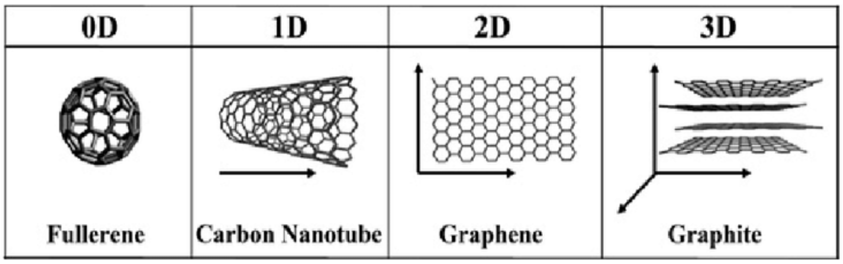
3.3 Taxonomy of Objectives:

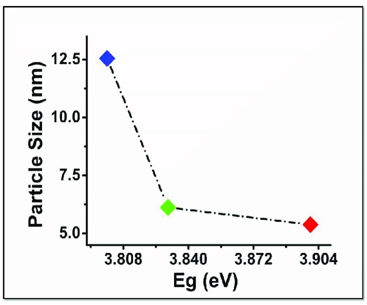
Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**		
Meta-Cognitive					**5**	**6**

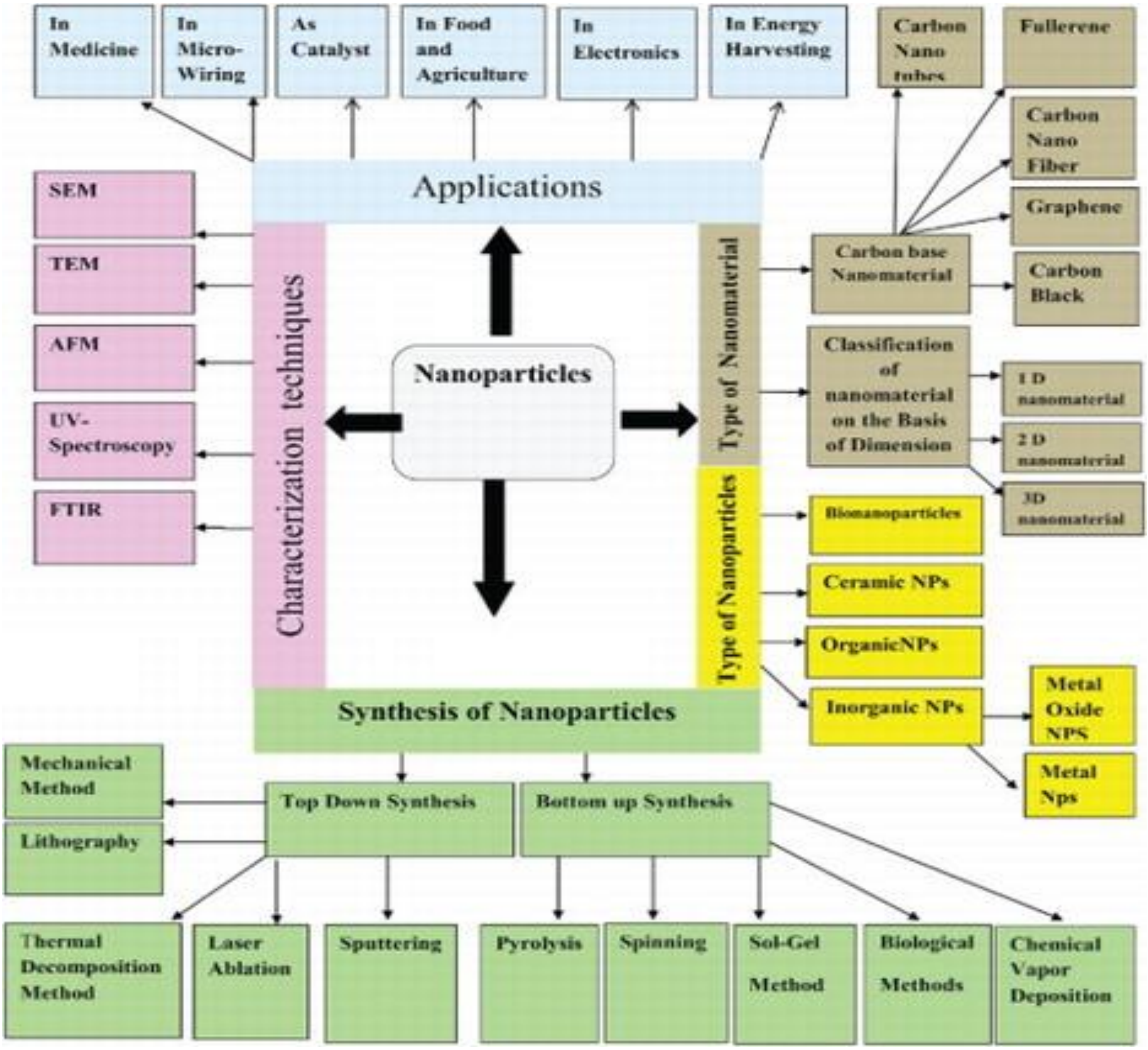
3.4. Key Words:

Nanostructures, quantum confinement, nanowires, nanoparticles, graphene, nanofabrication, surface area to volume ratio.

3.5. Key Diagrams:







4. Mind Map:

Nanostructures

Definition & Classification

Properties

Synthesis Methods

Applications

5. Summary:

Students will learn about the classification, unique properties, and synthesis methods of nanostructures. Emphasis will be placed on how nanostructures are enabling technological advancements in various fields.

6. Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts:

Discuss how nanostructures in sunscreen block harmful UV rays.

Analyze why nanoparticles show different colors compared to bulk materials.

7. FAQs:

1. What are the key differences between nanoparticles and bulk materials?
2. Explain the concept of quantum confinement and its significance in nanostructures.
3. What are some commonly used methods to synthesize nanostructures?
4. How do nanostructures impact the efficiency of solar cells?

8. References:

1. Poole, C. P., & Owens, F. J. (2003). *Introduction to Nanotechnology*. Wiley.
2. Cao, G. (2004). *Nanostructures and Nanomaterials: Synthesis, Properties, and Applications*. Imperial College Press.
3. Bhushan, B. (2017). *Springer Handbook of Nanotechnology*. Springer.

9. Verified by Subject Expert:

A. Nirmala Shirley

Course In-charge

Padmavathi P

Approved by HoD

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	IV
Subject Title	Quantum Mechanics II
Code	21PPHC41
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit & Title	Unit V: Relativistic Quantum Mechanics
Name of the Faculty	Ms. S.Saravana Selvi
T-L tools	Lecture method with step by step derivations, Visual aids: PPT, animations, and simulations. Demonstration: Real-world examples of relativistic effects.

Prerequisite Knowledge:

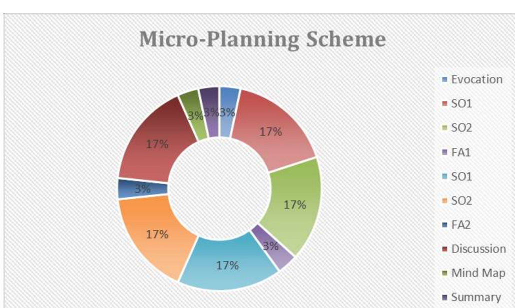
Students should have a basic understanding of:

Non-relativistic quantum mechanics principles.

The wave nature of particles and Schrödinger's equation.

Special relativity concepts (mass-energy equivalence, Lorentz transformations).

Micro-Planning:



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. Topic for Learning Through Evocation

Introduce the significance of relativistic quantum mechanics:

Why classical and non-relativistic quantum mechanics fail at high velocities.

Applications in particle physics and cosmology.

2. Topic Introduction

1. Klein-Gordon Equation:

   Derivation from the relativistic energy-momentum relation.

   Limitations (e.g., probabilistic interpretation issues).

2. Dirac Equation:

   Introduction to spin in quantum mechanics.

   Solutions for free particles and interpretation of negative energy states.

3. Spin-Orbit Coupling:

   Explanation of spin-orbit energy and fine-structure corrections.

4. Relativistic Hydrogen Atom:

   Study energy levels using the Dirac equation.

   Discussion on fine structures and experimental evidence.

3. Objectives:

3.1 General Objective:

To enable students to understand and analyze the principles of relativistic quantum mechanics.

3.2 Specific Objectives:

1. Derive the Klein-Gordon and Dirac equations.
2. Explore the physical implications of relativistic corrections.
3. Analyze spin-orbit coupling in atoms.
4. Examine the relativistic hydrogen atom.

3.3 Taxonomy of Objectives:

Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

3.4 Key Words:

Relativistic: Relating to high-velocity phenomena.

Klein-Gordon Equation: Relativistic wave equation for spin-0 particles.

Dirac Equation: Equation accounting for spin-1/2 particles and antimatter.

Spin-Orbit Coupling: Interaction between a particle's spin and orbital motion.

Fine Structure: Splitting of atomic energy levels due to relativistic effects.

4.Mind map

5.Summary:

Students will understand the transition from non-relativistic to relativistic quantum mechanics, focusing on the Klein-Gordon and Dirac equations, spin-orbit coupling, and the relativistic hydrogen atom.

6.Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts

1. What are the key limitations of the Klein-Gordon equation?
2. How does the Dirac equation incorporate spin?
3. Explain the physical origin of fine-structure corrections in hydrogen.
4. Why is spin-orbit coupling significant in atomic physics?

7.FAQs:

1. What are the limitations of the Klein-Gordon equation.
2. How does the Dirac equation account for antimatter?
3. What is the physical significance of spin-orbit coupling?
4. Why do we need relativistic quantum mechanics?
5. What are the applications of relativistic quantum mechanics?

8.References:

1. P. M. Mathews and K. Venkatesan. *A Text Book of Quantum Mechanics*. NewDelhi:Tata McGraw Hill Publishing Company Limited. 16^{th} reprint ,2^{nd} Edition 2007
2. R. Shankar. *Principles of Quantum Mechanics.* New York: Plenum Publishers. 2^{nd}Edition 1994.
3. J. J. Sakurai. *Modern Quantum Mechanics.* Addison- Wesley Publishing Company.Revised edition 1994.
4. 4. S. Rajasekar and R. Velusamy. *Quantum Mechanics I: Fundamentals.* London: CRCPress. Taylo and Francis group- Boca Raton. e-book version 2015

9. Verified by Subject Expert:

Course In-charge **Approved by HoD**

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	III
Subject Title	Solid State Physics II
Code	21PPHC42
Hours	6
Total Hours	90
Credits	5
Max Marks	100
Unit &Title	Unit II: Superconductivity–Type I and Type II Superconducors
Name of the Faculty	Mrs.Y.Sasikala
T-L tools	Lecture method,Visual aids: PPT, animations

Pre requisite Knowledge:

To study Type I and Type II superconductors, one should understand:

- Superconductivity Fundamentals: Key concepts like zero resistance, the Meissner effect, critical temperature (TcTc), and critical magnetic field (BcBc).
- Quantum Mechanics: Basic principles of electron pairing (Cooper pairs) and the BCS theory explaining superconductivity.
- Solid State Physics and Electromagnetism: Knowledge of crystal structures, electron interactions, and electromagnetic behavior in magnetic fields.

Micro-Planning:

Activity	Duration	Purpose
Evocation	**5min**	Generate interest in superconductors through Engaging questions or real-world examples (e.g., MRI machines, maglev trains).
Objective Presentation	**5min**	Present learning goals: understanding the principles of superconductivity, distinguishing betweenTypeIandTypeII superconductors,and their applications.
Explanation	**20min**	Discuss theoretical concepts: zero resistance, the Meissner effect,critical temperature(Tc), critical magnetic field (*Bc*), and electron pairing (Cooper pairs).
Demonstration	**10min**	Use simulations or videos to visualize the behavior of superconductors in magnetic Fields (e.g.,the levitation of magnets over superconductors).
Assessment and Discussion	**10min**	Facilitate a Q&A session to evaluate comprehension; ask students to explain concepts in their own words or solve Problems related to superconductivity.
Summary	**10min**	Recap key factors: definitions of Type I and Type II superconductors,their properties,the significance of the Meissner effect, and real-Life applications.

1. **Evocation (5 min)**

- Start with intriguing questions such as:
- "What happens to the resistance of certain materials when cooled to very low temperatures?"
- "How do maglev trains float above tracks without touching?"
- Use visuals, such as videos of magnetic levitation or MRI machines,to spark interest in superconductors**.**

2. **Objective Presentation (5min)**

- Clearly outline the session's objectives:
- Understand the principles of superconductivity.

- Distinguish between Type I and Type II superconductors.
- Explore real-world applications of superconductors in technology.

3. Explanation (20 min)

- Cover the following theoretical concepts:
- Definition of superconductivity and its key characteristics (zero electrical resistance and the Meissner effect).
- Explanation of critical temperature and critical magnetic field
- Discuss electron pairing (Cooperpairs) and its role in the formation of superconducting states.
- Differentiate between Type I (complete expulsion of magnetic fields) and Type II superconductors (partial penetration of magnetic fields).

4. Demonstration (10min)

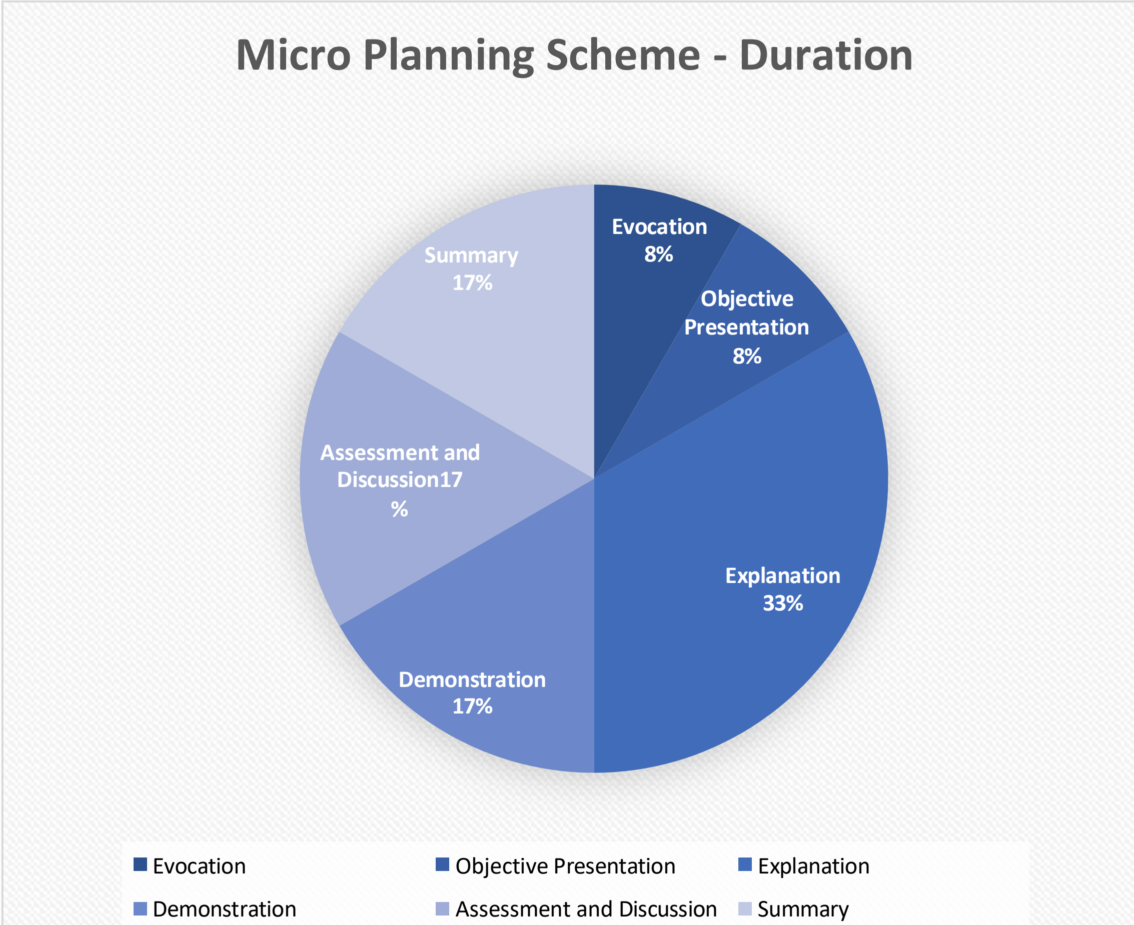
- Show simulations or videos that illustrate how superconductors behave in magnetic fields, such as the levitation of magnets over superconductors.
- If possible,demonstrate with physical models or experiments that visualize the Meissner effect.

5. Assessment and Discussion (10min)

- Engage students with questions such as:
- "What distinguishes Type I superconductors from Type II?"
- "Can you explain how Cooper pairs contribute to superconductivity?"
- Encourage peer-to-peer discussion to deepen understanding and clarify concepts.

6. Summary (5min)

- Recap the keypoints discussed during the session:
- Definitions of Type I and Type II superconductors and their properties.
- Importance of zero resistance and the Meissner effect in practical applications.
- Real-world applications of superconductivity, including MRI machines, maglevtrains, and particle accelerators.



General Objective:

- Understand Superconductivity Principles: Grasp key concepts like zero resistance and the Meissner effect.
- Distinguish BetweenTypes:Differentiate Type I andType II superconductors based on their magnetic properties and critical temperatures.
- Explore Applications: Investigate practical applications in technology,such as MRI machines and maglev trains.

Specific Objectives:

- Characterize Superconducting Behavior: Understand the distinct behaviors of Type I and Type II superconductors in response to magnetic fields.
- Analyze Magnetic Properties: Investigate the Meissner effect inType I and the mixed state in Type II superconductors.
- Explore Material Composition: Examine the materials that exhibit Type I (e.g.,lead) and Type II (e.g., niobium-titanium) superconductivity.
- Apply Superconductivity inTechnology: Assess practical applications of superconductors in technologies like MRI machines and maglev trains.

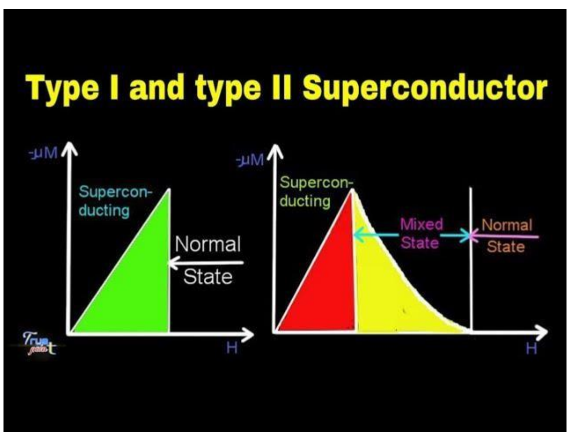
- **Taxonomy of Objectives:**

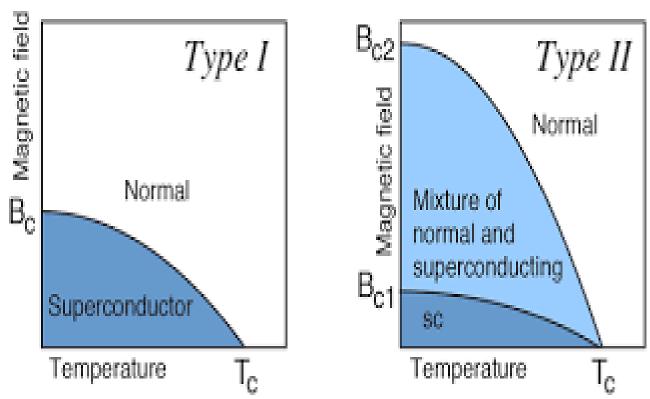
Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**	**5**	
Meta-Cognitive						**6**

Key Words:

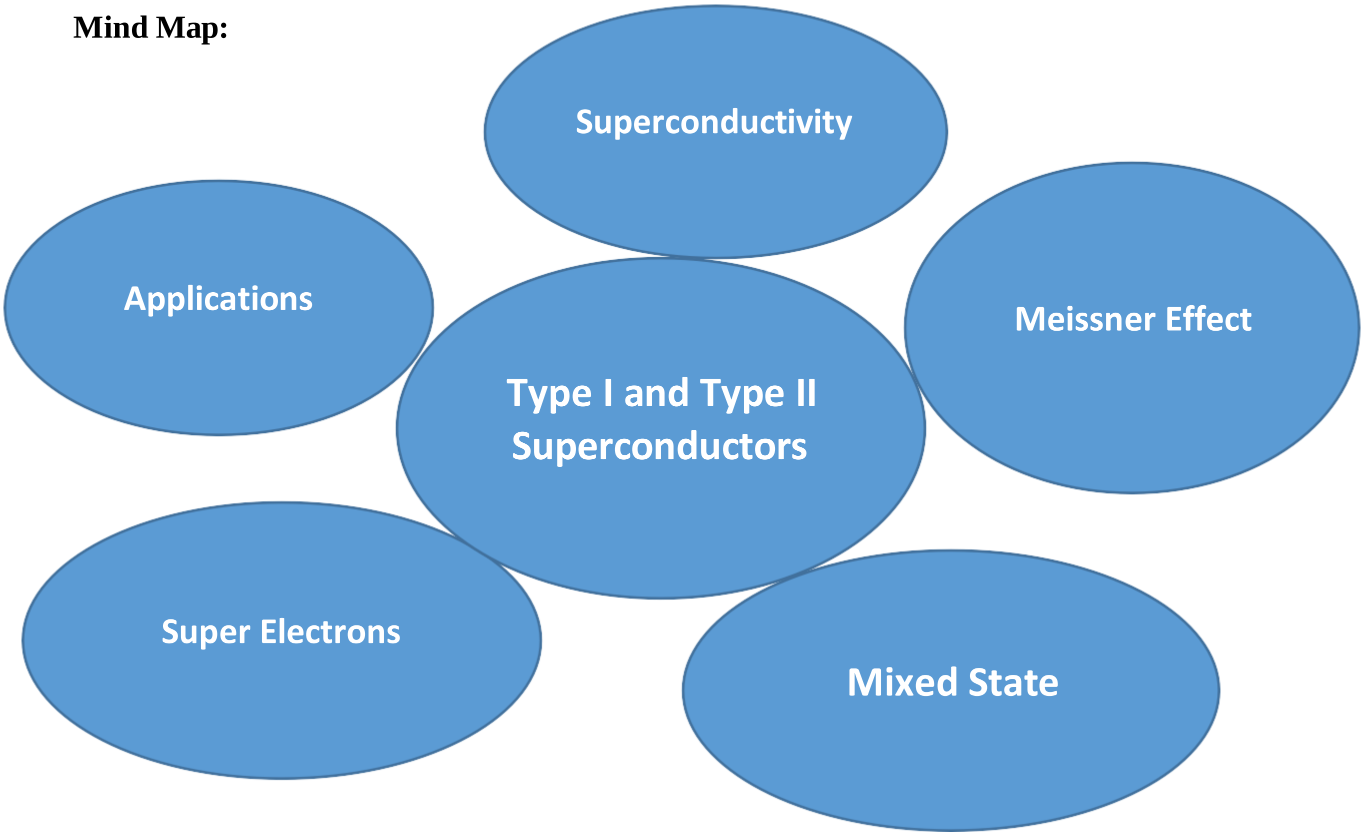
Superconductivity, Type I Superconductors, Type II Superconductors, Critical Temperature, Critical Magnetic Field, Meissner Effect, Cooper Pairs, London Penetration Depth,Coherence Length

KeyDiagram:





Mind Map:



Assessment Questions

1. Why do TypeII superconductors allow partial penetration of the magnetic field,unlike Type I?
2. Compare and contrast the applications of Type I and Type II superconductors.
3. Why do high-temperature superconductors belong to Type II superconductors?
4. What happens when a magnetic field stronger than the upper critical field (Hc2) is applied to a Type II superconductor?
5. How does the presence of impurities or defects affect the superconducting properties of Type I and Type II superconductors?

References:

1. Pillai SO. Solid State Physics. New Age International (P) Limited. Reprint, 8th Edition 2018.
2. Charles Kittel. Introduction to Solid State Physics.Wiley Publications. Reprint 2019.
3. Puri RK, Babbar VK. Solid State Physics. New Delhi: S Chand Publications. Reprint, First Edition. 2021.
4. Palanisamy PK. Solid State Physics. Chennai: Scitech publications Private Ltd. Reprint. 2013.

5. Wahab M A. Numerical Problems in Solid State Physics. Narosa Publishing house Pvt. Ltd. Reprint.2019.
6. Ali Omar M,Elementary Solid- State Physics Principle and Applications. Pearson Publication. Reprint. 2019.

Verified by Subject Expert:

Course In - charge **Approved by HoD**

Co-ordinator
Department of Physics (SSC)
St. Mary's College (Autonomous)
Thoothukudi.

LESSON PLAN

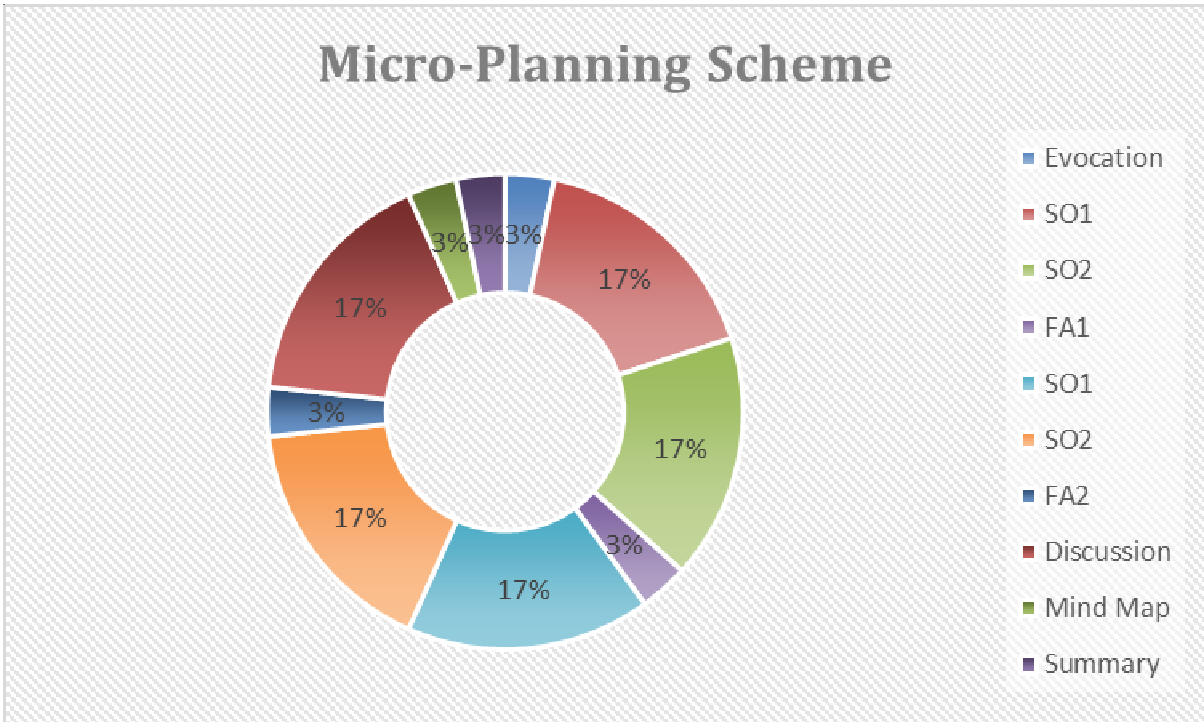
Objective Oriented Learning Process RBT

Programme	M.Sc Physics
Semester	IV
Subject Title	Nuclear and Particle Physics
Code	21PPHC43
Hours	6
Total Hours	90
Credits	4
Max Marks	100
Unit & Title	Unit III: Nuclear Chain Reaction
Name of the Faculty	Ms. A Nirmala Shirley
T-L tools	Lecture method, Visual aids: PPT, animations of chain reactions in fission processes, Videos: Demonstrations of controlled and uncontrolled chain reactions, Practical examples: Nuclear reactor models.

Prerequisite Knowledge:

Students should be familiar with basic nuclear concepts like atomic structure, nuclear fission, and neutron interactions.

Micro-Planning:



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. Topic for Learning Through Evocation:

Introduce nuclear chain reactions by discussing their real-world significance:

- Powering nuclear reactors.
- Use in nuclear weapons.

Ask students to recall the concept of nuclear fission and discuss how splitting one atom can lead to energy release and further reactions.

2. Topic Introduction:

1. **Definition**: A nuclear chain reaction is a series of nuclear fissions (splitting of atomic nuclei), where each fission releases neutrons that trigger further fissions, leading to a self-sustaining sequence.
2. **Types**:
   - Controlled chain reaction (used in nuclear reactors).
   - Uncontrolled chain reaction (used in nuclear weapons).
3. **Conditions for a Chain Reaction**:
   - Critical mass of fissile material.
   - Proper arrangement and geometry of the material.
   - Sufficient neutron generation and moderation.

3. Objectives:

3.1 General Objective:

Enable students to understand the mechanism of nuclear chain reactions and their applications.

3.2 Specific Objectives:

1. Define and explain the concept of a nuclear chain reaction.
2. Describe the difference between controlled and uncontrolled chain reactions.
3. Explain the critical mass concept and factors affecting chain reactions.
4. Analyze the importance of moderators and control rods in reactors.
5. Discuss real-world applications and safety measures in nuclear reactors.

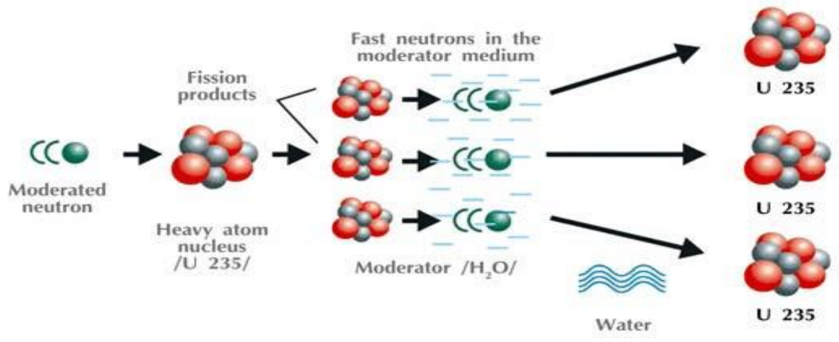
3.3 Taxonomy of Objectives:

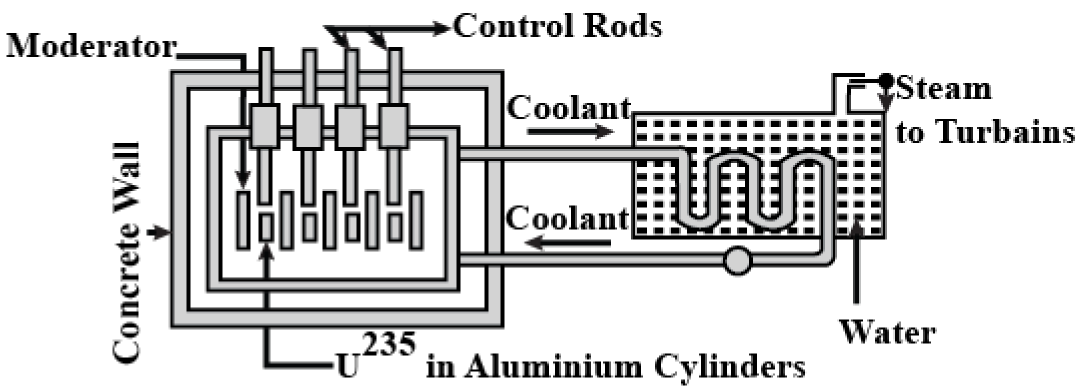
Taxonomy of Objectives						
Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**1**					
Conceptual Knowledge		**2**	**3**			
Procedural Knowledge				**4**		
Meta-Cognitive					**5**	**6**

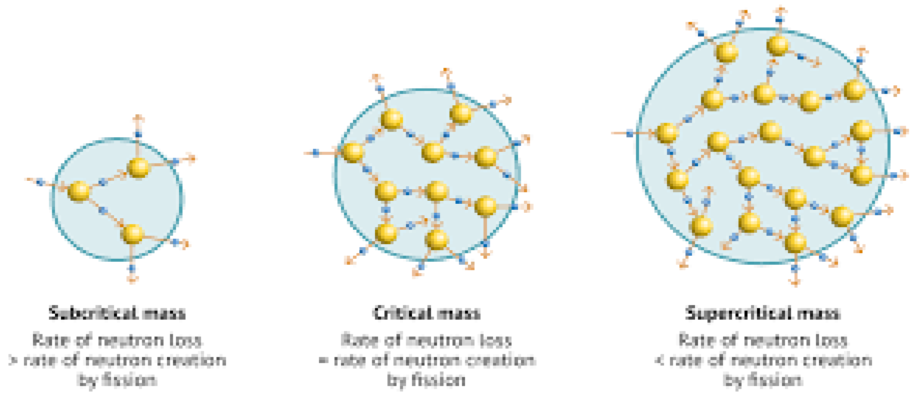
3.4. Key Words:

Nuclear chain reaction, fission, critical mass, neutron moderation, controlled reaction, uncontrolled reaction, nuclear reactor.

3.5 Key Diagrams:







4. Mind Map:

- Nuclear Chain Reaction
- Definition and Process
- Types
- Critical Mass & Conditions
- Applications

5. **Summary:**

Students will learn the mechanisms behind nuclear chain reactions, the distinction between controlled and uncontrolled reactions, and their practical applications in reactors and weapons. The emphasis will be on the role of safety measures and technology in harnessing nuclear energy.

6. **Assessment Through Stimulating Questions/Analogy/New Ideas and Concepts:**

Discuss how chain reactions power nuclear power plants.
Analyze why control rods are essential in reactors.

7. **FAQs:**

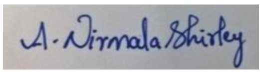
1. What is the basic principle behind a nuclear chain reaction?
2. Explain the significance of moderators and control rods in a nuclear reactor.
3. What is the difference between subcritical, critical, and supercritical mass?
4. How does a nuclear reactor prevent a meltdown?

8. **References:**

1. Krane, K. S. (1988). *Introductory Nuclear Physics*. Wiley.

2. Fermi, E. (1950). *Nuclear Physics: A Course Given by Enrico Fermi*. University of Chicago Press.
3. Glasstone, S., &Sesonske, A. (1994). *Nuclear Reactor Engineering*. Springer.

9. Verified by Subject Expert:



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