



**ASSOCIATION OF ALL
COMPUTER SCIENCE TEACHERS (AACST)**
कॉम्प्यूटर विज्ञान शिक्षक संघ [Reg. No: Nagpur/0000492/2023] September 2023

**A REPORT ON
NATIONAL LEVEL ONLINE WORKSHOP
QUANTUM REVOLUTION A JOURNEY AROUND ORBIT (QRaJAO)
4TH TO 13TH FEBRUARY 2025**

**ORGANIZED BY
AACST & IAPT RC 12 A**

**MENTOR & CONVENER
DR. ABHA KHANDELWAL
FOUNDER, AACST**

**COORDINATOR
PROF SARMISTH SAHU
IAPT RC 12A**



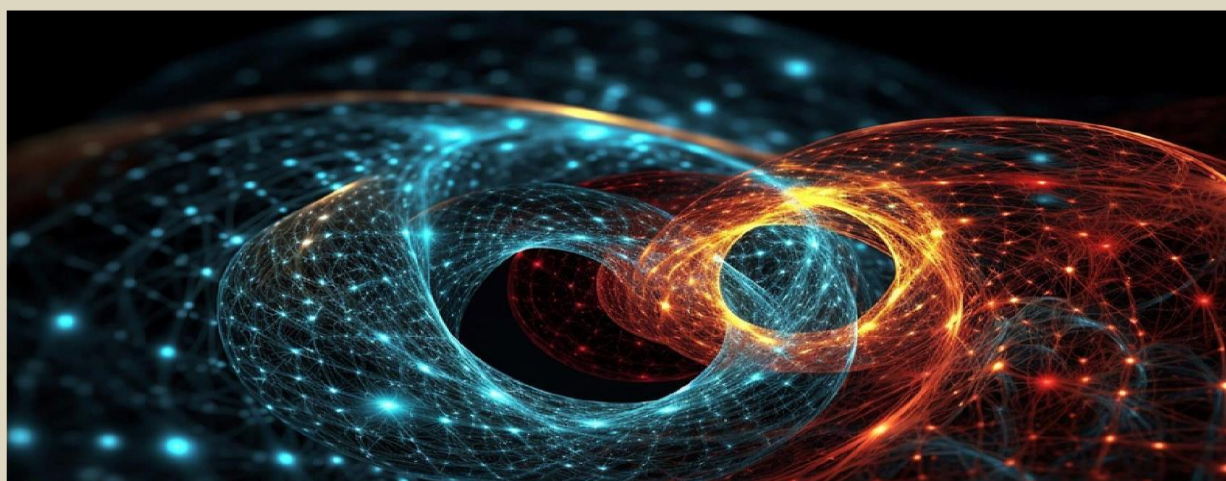
INDIAN ASSOCIATION OF PHYSICS TEACHER–SRC 12A &
ASSOCIATION OF ALL COMPUTER SCIENCE TEACHERS



Celebrate IYQ -2025

QUANTUM REVOLUTION a Journey Across Orbits

QR aJAO



Empowering Education –

A Paradigm Shift

Event Details:

February 4, 5, 6, 7, 10, 11, 12, 13 2025

Time: 6:00 – 8:00 pm

Duration: 8 Sessions

Mode: Online on Zoom

Target Participants: Teacher, Research Scholars,
Post-Graduate & Under -Graduate Students

Registration Fees: Students: Rs. 400

Teachers & Research Scholars: Rs 600

Registration Link:

<https://forms.gle/WT9kBEQvLwJRqVET8>

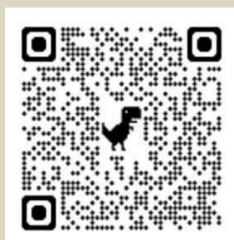
Registration QR code>

Payment QR Code next page

For Direct transfer to Bank

Bank Name: Canara Bank,
Branch: Malleswaram Branch
Account Name: IAPT RC12A
Account No.: 04752010003124
IFSC: CNRB0010424

LIMITED SEATS LEFT BOOK YOUR SPONTOW!



QUANTUM REVOLUTION a Journey Across Orbits

QR aJAO



Visualizations
of Qubits and
Quantum
Tunnelling



Hands-on
Coding
Sessions
using Python
& Qiskit



Real-world
Applications
and Problem
Solving

Interactive Activities



Quantum
Principles



Famous
Quantum
Experiments



Quantum Dots,
Tunnelling and
Entanglement



Quantum
Cryptography and
Post Quantum
Cryptography



Quantum
Gates and
Circuits

Workshop Highlights



Dr. Abha Khandelwal
Visionary Change Maker



Dr. Shadab Hussain
International Quantum Computing Expert



Dr. Kishore Ch. Pati
Quantum Trailblazer



Dr. Jyoti Ghushe
Magnetic Academician



Dr. Bhakti Rajvaidya
Captivating Academician

Last Date for Registrations
– Feb 2, 2025
Participation e-
Certificates for Registered
Participants Only
Zoom Links to be shared
by
February 4, 2025



Dr. Ojas Garg
Inspiring Scholar



Dr. Sumit Pakhare
Computational Expert



Mrs. Sarmistha Sahu
Secretary RC12A
Coordinator
Dr. Abha Khandelwal
Founder, AACST
Convener & Mentor

Contact:
subr12a.iapt@gmail.com
Secretary RC12A
94484 37747
Treasurer RC12A
94803 66286



Target Audience:

- ✓ **Teachers & Researchers** – To expand their expertise and incorporate quantum computing concepts into academic curriculum.
- ✓ **Postgraduate & Undergraduate Students** – To develop a strong foundation in quantum computing and explore its real-world applications.

Number of participants: 85

Convener & Mentor: Dr. Abha Khandelwal, Retired Head, Dept of Computer Science, Hislop College, Nagpur &, Founder, AACST

Coordinator: Sarmistha Sahu

Event Overview:

The **National Level Online Workshop**, *Quantum Revolution: A Journey Across Orbits (QRaJAO)*, was organized by the **Association of All Computer Science Teachers (AACST)** in collaboration with **IAPT RC 12A** to commemorate the **International Year of Quantum (IYQ) 2025**. The workshop served as an interdisciplinary platform aimed at **empowering education through a paradigm shift in quantum technologies**.

This **eight-day online event**, conducted via Zoom, brought together **teachers, research scholars, and undergraduate/postgraduate students** to explore the **fundamentals and cutting-edge advancements in quantum computing**. Featuring **expert speakers, hands-on sessions, and interactive discussions**, the workshop bridged the gap between theory and real-world applications in fields such as **quantum cryptography, artificial intelligence, drug discovery, finance, data analytics, and sustainable computing**.

Resource persons:

1. Dr. Jyothi Manish Ghush, PICT Model School, Pune
2. Dr. Ojas Garg, Vaish College, Rohtak, Haryana.
3. Dr. Bhakti Patankar Rajvaidya, Assistant Professor in Physics at G.H. Rasoni College of Engineering, Nagpur
4. Dr. Sumit Pakhare, Assistant Professor, Priyadarshini College of Engineering, Nagpur.
5. Dr. Abha Khandelwal, Retired Head, Dept of Computer Science, Hislop College, Nagpur & Founder Director, AACST
6. Dr. Shadab Hussain, Senior Associate, MathCo, Texas U.S.
7. Dr. Kishor Pati, NIT Rourkela.

Session Chairpersons:

1. Prof P C Deshmukh, Mentor of CAMOST, Prof IIT Tirupati and ISER Tirupati
2. Prof. K N Joshipura, retd Prof. Sardar Patel University., Anand, Gujrat
3. Dr. M K Raghavendra, Program Manager, Axis Bank Centre, IISc, Bangalore

4. Dr. Y C Sharma, Director, Research and Development, Jaipur National University, Jaipur
5. Dr. Chetan M, Assistant Professor, Jain University, Bangalore
6. Dr. Shivalingaswamy T, Prof of Physics, Maharani Science College, Mysuru and President RC12A .
7. Dr. K S Mallesh, former Chairman and former Prof. University of Mysore, Mysore
8. Prof P K Ahluwalia, Professor of Physics (Retd.), Himachal Pradesh University & IAPT President, Shimla

Master of Ceremony:

1. Sarmistha Sahu Retd. Prof of Physics, Coordinator, Ammanni IAPT Anveshika (Wing of NANI, Indian Association of Physics Teachers), Bangalore 560097
2. Dr Minal Gupta

Course Contents:

Session 1: Introduction to Quantum Computing, Key Quantum Principles, and Beam Splitter Simulator Experiment, Schrodinger's cat

Theoretical Concepts and Exercises

Objectives:

Understand the foundational concepts of quantum computing and its significance. Explore the transition from classical bits to quantum bits (qubits). Understanding qubits through Double-Slit Experiment: Wave-particle duality. Beam splitter simulator, Schrodinger's cat
Examine future trends and emerging technologies in quantum computing.

Topics Covered:

Core principles: **Superposition, entanglement, and interference.** Bits vs. Qubits: Bloch sphere representation.
Real-world applications of quantum computing in science and technology.

Session 2: Famous Experiments in Quantum Mechanics, Stern-Gerlach Experiment, Quantum Dots, Quantum Tunneling

Theoretical Concepts and Exercises

Objectives:

Connect theoretical principles to experimental validations in quantum mechanics. Introduce quantum dots and tunnelling phenomena, with a focus on applications in quantum computing and nanotechnology.

Topics Covered:

Stern-Gerlach Experiment: Measurement of quantum spin.

Quantum Dots: Properties, fabrication, and uses in electronics and quantum devices.

Quantum Tunneling: Explanation and applications (e.g., scanning tunneling microscopes, tunnel diodes). Intersection of quantum dots with quantum computing and cryptography.

Session 3: Bell's Inequality Tests, Quantum Entanglement, Quantum Teleportation Theoretical Concepts and Exercises

Objectives:

Delve into entanglement and its experimental evidence.

Topics Covered:

Bell's Inequality Tests: Verifying **quantum entanglement**.

Quantum Teleportation: Principles and protocols.

Real-world implications of these experiments for quantum computing.

Session 4: The Need for Quantum Computers and Research Opportunities for Physicists

Why Quantum Computers?

Limitations of classical computers: Speed, energy consumption, scalability. Quantum advantages: Solving NP-hard problems, energy efficiency.

Global and Indian Progress

Global milestones: IBM, Google, China's advancements.

India's initiatives: National Quantum Mission, startups, and academic contributions.

Research Areas for Physicists

Quantum hardware: Superconducting qubits, ion traps, photonics. Quantum algorithms, error correction, and simulations.

Applications: Drug discovery, material science, cryptography, climate modeling.

Structured Approach to Quantum Research

Learning path: Basics of quantum mechanics, hands-on tools like Qiskit.

Participation in hackathons, mini-projects, and online courses.

Long-term focus on publishing papers and advanced applications.

Future Outlook

Opportunities in interdisciplinary research.

Global demand for quantum scientists and researchers.

Session 5: Quantum Cryptography, One-Time Pad encryption, Theoretical Concepts and Exercises

Objectives:

Understand the foundational aspects of Traditional and Quantum cryptography.

Topics Covered:

Principles of quantum cryptography and quantum-safe cryptography.

Quantum Key Distribution (QKD): BB84 Protocol.

Visualize Transition through Quantum

Channel One Time Pad encryption

(Exercises)

Session 6: POST Quantum Cryptography, AI-Based Attacks, Real-World Applications & Industry Use Cases

Theoretical Concepts and Exercises

Objectives:

Explore the concepts in post quantum cryptography and Real world Application

Topics Covered:

1. Introduction to Post-Quantum Cryptography (PQC)

- Understanding the threat posed by quantum computing to classical systems
- Timeline and urgency for transitioning to PQC
- Key security challenges in the quantum era

2. NIST-Recommended PQC Algorithms

- Overview of NIST's PQC standardization process
- Selected algorithms: Lattice-Based, Hash-Based, Multivariate

- c. How these algorithms provide security against quantum threats
- 3. AI-Based Attacks & Quantum-Inspired Defense Mechanisms**
 - a. How AI enhances cryptographic attacks
 - b. Developing Quantum-Inspired Algorithms for cyber threat detection
 - c. AI's role in strengthening cryptographic resilience in a post-quantum world
- 4. Real-World Applications & Industry Use Cases**
 - a. Finance: Securing financial transactions, blockchain, and digital payments
 - b. Healthcare: Protecting data, medical devices, & secure AI-driven diagnostics
 - c. National Security: Secure communications, encryption, and data protection
- 5. The Role of Big Tech in PQC Transition**
 - a. Efforts by Google, IBM, and others in developing and adopting PQC
 - b. Integration of PQC into cloud security, VPNs, & enterprise frameworks
 - c. Challenges in large-scale deployment and roadmap for industry-wide adoption
- 6. Future Outlook & Takeaways**
 - a. Next steps in PQC adoption for enterprises and governments
 - b. Policy & regulatory considerations in the transition to quantum-safe cryptography
 - c. Key takeaways and recommendations

Session 7: Quantum Gates and Circuits **Theoretical Concepts and Exercises**

Objectives:

Learn the building blocks of quantum computation.

Topics Covered:

Quantum gates: X, Y, Z, H, CNOT, and their matrix representations.

Building simple quantum circuits.

Visualizing quantum logic operations.

Session 8: Quantum Algorithms **Theoretical Concepts and Exercises**

Objectives:

Understand the significance of quantum algorithms in solving computational problems.

Topics Covered:

Deutsch's algorithm: A first look at quantum advantage. Grover's

algorithm: Quantum search.

Shor's algorithm: Breaking classical cryptography.

Highlights of the Workshop

- ✓ Every day, sessions began on time—allowing a modest grace period of five minutes—reflecting our collective discipline and commitment.
- ✓ The course contents were meticulously curated by Convener **Dr Abha Khandelwal**, aligning perfectly with the workshop's objective of introducing and deepening participants' understanding of quantum science, computing, research and applications.
- ✓ All seven resource persons, each having mastery in their domain, effectively delivered their sessions.

- ✓ Every one's unique teaching style made every session engaging and impactful.
- ✓ A variety of tools, from **Python programs and Qiskit Quantum Computing Framework, short YouTube videos, Quantum simulation for Quantum principles, Lottie Files,** For lightweight animations (GIF-like), Notes in PDF files were employed to bring complex quantum concepts to life.
- ✓ **The resource persons collectively simplified even the most challenging quantum concepts,** ensuring participants left with clarity and confidence. Indeed, each session sparked a new flame of curiosity and discovery.
- ✓ **Daily assessment** links posted in Google Classroom ensured continuous judgement of participants learning during sessions. Participation certificates were awarded to those meeting the criteria.
- ✓ Sessions were **highly interactive**, with robust Q&A segments following each lecture.
- ✓ **Additional Assignments** were given in two sessions.
- ✓ **Recorded Lectures** were made available on Google Classroom for revision before assessment.

The Workshop Journey

The workshop began with **Session 1 on 4th February**, delivered by **Dr. Jyoti Ghushe**, on *Introduction to Quantum Computing, Key Quantum Principles, and the Beam Splitter Simulator Experiment*. She brilliantly explained core principles like superposition, entanglement, and interference, along with a comparison between classical bits and qubits. This session was chaired by **Prof. P C Deshmukh**, Mentor of CAMOST and Professor at IIT Tirupati and IISER Tirupati, who captivated everyone with his visuals illustrating the intriguing relationship between determinism and probability in quantum phenomena.

In **Session 2 on 5th February**, **Dr. Ojas Garg** rocked the session with his excellent explanation of *Famous Experiments in Quantum Mechanics*, such as the *Stern- Gerlach Experiment, Quantum Dots, and Quantum Tunneling*. **Prof. K N Joshipura**, retired professor from Sardar Patel University, Anand, Gujarat added an engaging touch with a video of a live black body changing colors at different temperatures.

On **6th February, Session 3**, **Dr. Bhakti Patankar Rajvaidya** delivered a self-explanatory presentation on *Bell's Inequality Tests, Quantum Entanglement, and Quantum Teleportation*. which left participants spellbound. She mesmerised everyone with her beautifully designed presentation and explanation.

The chairperson of the session Dr. M K Raghavendra, Program Manager at Axis

Bank Centre, IISc, highlighted the growing importance of computing skills for physics students.

Dr. Sumit Pakhare led **Session 4 on 7th February**, explaining *The Need for Quantum Computers and Research Opportunities for Physicists*. He outlined global milestones, India's initiatives, and provided a structured approach to quantum research in terms of the growing global demand for quantum scientists. He provided a structured roadmap for quantum research and highlighted opportunities for physicists. He also effectively conveyed the diverse research areas in quantum computing for other domain, from quantum hardware to quantum algorithms, inspiring participants to explore interdisciplinary opportunities.

This session was chaired by Dr. Y C Sharma, Director, Research and Development, Jaipur National University. He emphasized the immense research potential in Quantum Computing, encouraging physics students to seize the opportunities in this rapidly evolving area.

10th February, Dr Abha Khandelwal delivered **Session 5 on Quantum Cryptography and One-Time Pad Encryption**, covering the **BB84 Protocol** and simulating **Quantum Key Distribution (QKD)** using Qiskit. Participants engaged in exercises to generate shared keys, which helped them grasp the practical aspects of quantum cryptography. The session also included solving an exercise on transmitting crucial messages using the secret key generated through QKD and one-time pad encryption, ensuring secure communication. This hands-on approach made the session an enriching and insightful experience for all participants, bridging theory with practical implementation.

The Chairperson, **Dr. Chetan M**, Assistant Professor at Jain University with his remarkable communication skills, beautifully concluded a thought-provoking lecture of QKD and on simulation of quantum cryptography.

In **Session 6 on 11th February**, The One of the most exciting features was our session with an **international speaker** showcasing the power of the digital world to connect minds across continents. **Dr. Shadab Hussain from Texas, US introduced** *Post-Quantum Cryptography, Lattice based, Code Based, Hash Based PQCs, AI- Based Attacks, and Real-World Applications*. He elaborated on NIST-recommended algorithms and how AI can strengthen cryptographic resilience. The session was extensively informative.

The chairperson, Dr. **Shivalngaswamy T**, Prof of Physics, Maharani Science College,

Mysuru and President RC12A . He praised the topic that resonates perfectly with our increasingly digital lives.

We paused on **12th February** to remember **Prof. D P Khandelwal**, founder of IAPT. **Prof. P K Ahluwalia** walked us through his life and contributions, offering a heartfelt tribute to this visionary leader. Prof Ahluwalia highlighted his teachings, and his ideas, which are remarkably relevant even today, inspiring us to adopt and embody them in our lives.

Thereafter **Session 7** , was delivered by **Dr. Kishor Chandra Pati** on *Quantum Gates and Circuits*. He explained various quantum gates, Pauli gates X Y and Z and Hadamard Gate, S gate, T gate, Inner, Outer and tensor products, and matrix representations, Normalization of Vectors, Orthonormal vectors covering every minute detail in a clearly understandable way. **Prof. K S Mallesh** chaired the session simplified the session further for UG students, translating quantum language into plain English.

Finally, **Session 8 on 13th February**, also conducted by **Dr. Kishor Chandra Pati**, focused on C NOT Gate Swap gate, *Quantum Circuits and Deutsch's algorithm*. He beautifully explained Deutsch's algorithm, a fascinating quantum breakthrough that elegantly demonstrates how a single quantum query can reveal the hidden nature of a function, far surpassing classical limits and paving the way for future computational possibilities.

This session was chaired by **Prof. P K Ahluwalia**, making it a perfect conclusion to the workshop by showcasing quantum advantage in solving complex problems.

Course Outcomes:

By the end of this workshop, participants will:

- ✓ **Grasp fundamental quantum computing principles**, including quantum mechanics concepts, quantum gates, circuits, and essential algorithms.
- ✓ **Gain hands-on experience with quantum computing frameworks** like Qiskit and simulators for designing and executing quantum circuits.
- ✓ **Develop the ability to implement and analyze quantum algorithms** for diverse applications, enhancing problem-solving skills in this emerging field.
- ✓ **Apply quantum computing techniques across multiple domains**, such as cybersecurity, artificial intelligence, healthcare, finance, and environmental sustainability.
- ✓ **Identify key research challenges and opportunities in quantum computing**, equipping themselves with insights into future advancements and career pathway

Validatory Function

The valedictory function marked the culmination of the AACST QRaJAO Workshop. The event went well and expressed gratitude to key contributors.

Acknowledgments

The success of the AACST AAJAO Workshop was made possible by the dedicated efforts of numerous individuals. We extended our sincere appreciation to:

- **The 8 Chairpersons:** Thank you for your leadership and guidance throughout the workshop.
- **The Coordinator:** Your organizational skills and attention to detail were invaluable.
- **The Convener:** Thank you for bringing everyone together and ensuring the smooth execution of the workshop.
- **The 7 Resource Persons:** Your expertise and insights enriched the learning experience for all participants.
- **All the Participants:** Your contributions are greatly appreciated.

Future Implications:

As quantum technology continues to evolve, **QRaJAO** served as a crucial platform for fostering **awareness, skill- building, and research collaborations**. The workshop encouraged participants to explore **emerging career and research opportunities** in quantum computing and its **transformative role across industries**.

This event exemplified **AACST and IAPT's commitment** to driving technological literacy and innovation in quantum sciences, laying the groundwork for **future initiatives in quantum education and research**.

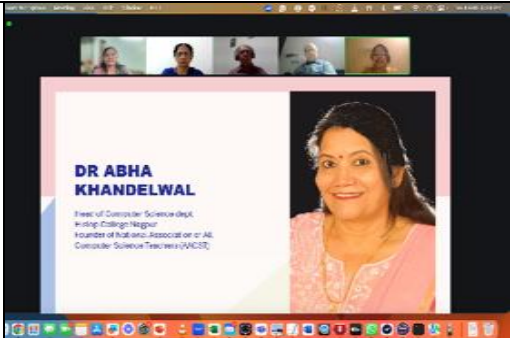
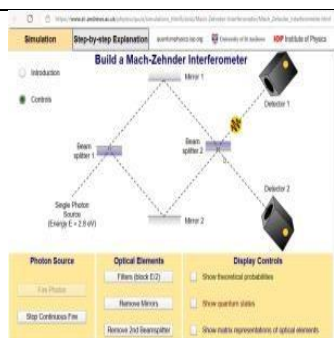
Acknowledgment & Gratitude

A heartfelt **thank you** to all members of resource **person's team** for their **dedication, brilliance, and unwavering support** throughout the workshop. Thanks for **attending pre-workshop meetings whenever called upon**, which played a crucial role in making this event a success.
"Each teacher ignited a flame, and together, they created a bonfire of knowledge."

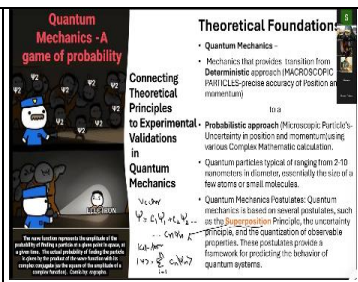
A heartfelt appreciation to all participants for their enthusiasm, perseverance, and active engagement. Your thought-provoking questions, insightful reflections, and constructive feedback enriched every session, making the learning experience truly valuable.

Our deepest gratitude to **Coordinator Prof. Sarmistha Sahu** for her dedication and efforts, and to everyone who contributed, directly or indirectly, to the success of this event.
A special thanks to **President Dr. S. B. Kishor** for his moral support and to **Secretary Dr. Pravin Goshekar** for his timely assistance, ensuring the smooth conduction of the program.

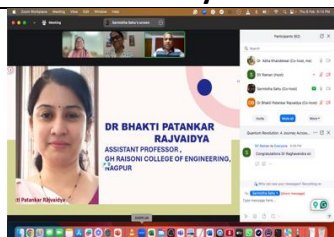
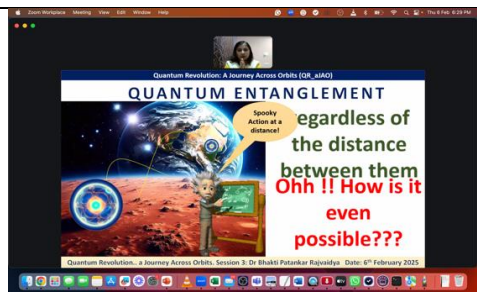
Day 1: 4th February 2025 6:00 to 8:00 PM

		
Dr. Minal Gupta Master of Ceremony	Mentor & Convener	Coordinator
		
Dr. Jyoti Ghushe Resource person	Prof. P C Deshmukh Chairperson	Session in Progress

Day 2: 5th February 2025 6:00 to 8:00 PM

		
Dr. Ojas Garg Resource person	Prof. K N Joshipura Chairperson	Session in Progress

Day 3: 6th February 2025 6:00 to 8:00 PM

		
Dr. Bhakti Rajvidhya Resource person	Dr. M K Raghavendra Chairperson	Session in Progress

Day 4: 7th February 2025 6:00 to 8:00 PM

		
Dr Sumit Pakhare Resource person	Dr. Y C Sharma Chairperson	Session in Progress

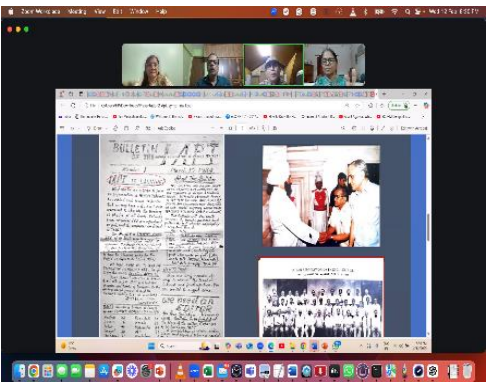
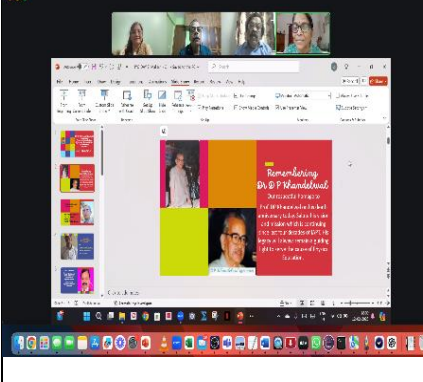
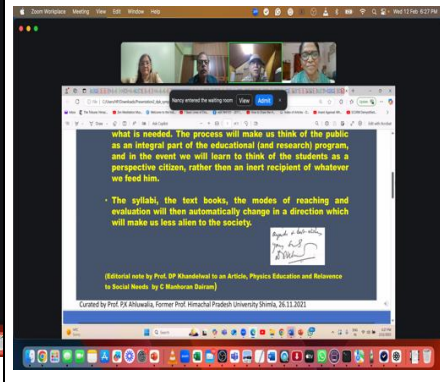
Day 5: 10th February 2025 6:00 to 8:00 PM

		
Dr. Abha Khandelwal Resource person	Dr. Chetan M Chairperson	Session in Progress

Day 6: 11th February 2025 6:00 to 8:00 PM

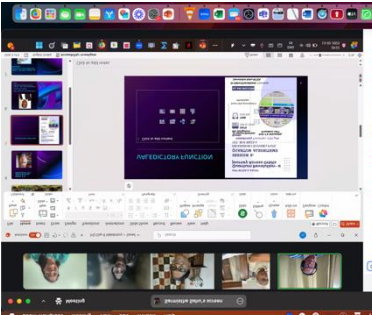
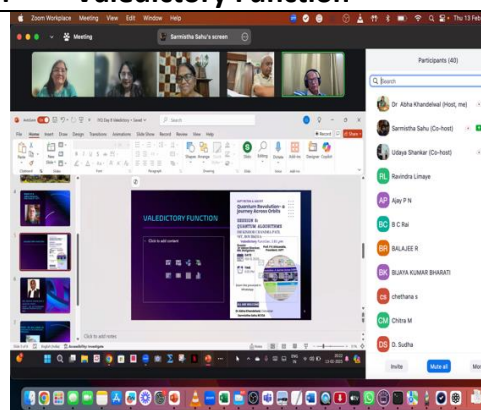
		
Shadab Hussain Texas U S. Resource person	Chairperson Dr. Shivalngaswamy T	Session in Progress

Day 7: 12th February 2025 6:00 to 8:00 PM

		
Homage to Prof D P Khandelwal 12/02/1996)	A Tribute to FOUNDER IAPT	Shat Shat Pranam
		
Dr. Kishor Pati Resource person	Dr. K S Mallesh Chairperson	Session in Progress

Day 8: 13th February 2025 6:00 to 8:00 PM

Valedictory Function

 		
Dr. Kishor Pati Resource person	Prof P K Ahluwalia Chairperson	Valedictory Function



MYTH	FACT
Things happen differently in the classical world and in the quantum world.	There are no two worlds; there is only the physical universe in which we live. Things happen the way they do in this world according to the laws of nature. <i>Classical Physics and Quantum Physics are different theories whose goal is to understand and explain the laws of nature.</i>

Report Prepared By:

DR. ABHA KHANDELWAL

CONVENER QRaJAO

Assisted By: DR. OJAS GARG