



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

**REPORT
ON
NATIONAL LEVEL ONLINE WORKSHOP
QUANTUM QUEST: PRINCIPLES, SECURITY AND APPLICATIONS
11TH TO 14TH & 16TH AUGUST 2025**

**ORGANIZED BY
AACST BANGALORE UNIT**

**MENTOR:
DR. ABHA KHANDELWAL
FOUNDER, AACST**

**WORKSHOP CONVENER:
DR. CHITRA RAVI
AACST BANGALORE UNIT EVENT COORDINATOR**



ASSOCIATION OF ALL COMPUTER SCIENCE TEACHERS (AACST)

कॉम्प्यूटर विज्ञान शिक्षक संघ | Reg. No: Nagpur/0000492/2023 | September 2023

ONLINE WORKSHOP

QUANTUM QUEST: PRINCIPLES, SECURITY AND APPLICATIONS

Join us for an exhilarating journey into the world of Quantum Computing!

11th to 14th & 16th August 2025 (5 DAYS)

6:30 TO 8:00 P.M

REGISTRATION

Early Bird Registration & AACST members (upto 31st July 2025) : **Rs. 400/-** per participant
 (From 1st August 2025 to 10th August 2025) **Rs. 500/-** per participant

Course Highlights

- Sessions led by expert faculty members
- Exploration of cutting-edge technology
- Hands-on experience with Quantum computing tools
- Course completion certificate

As the world moves closer to the quantum era, understanding the role of quantum computing in next-generation computing, communication, security and applications has become essential. This cutting-edge workshop, "Quantum Quest: Principles, Security and Applications" is designed to offer insights into quantum computing principles, quantum gates and circuits, quantum algorithms, quantum cryptographic protocols, and applications of emerging quantum-enabled technologies.

Secure your spot now and be part of the quantum revolution!

Resource Persons


 Dr. Praveen Parthasarathi


 Dr. H Aswathaman


 Dr. S Kathiresan


 Dr. Abha Khandelwal


 Dr. Chitra Ravi

Scan to Pay



Scan to Register



Mentor: Dr. Abha Khandelwal, Founder, AACST
 Workshop Convener: Dr. Chitra Ravi, Director Academics, Department of Computer Science, Maharani Lakshmi Ammanni College for Women Autonomous, Bangalore & Research Director, Cybersense (R&D) India Pvt. Ltd., Bangalore

Target Audience: Students/Faculty members/Research scholars/Educators/Professionals

Schedule

Session No.	Date/Day/Time	Topic	Resource person
Session 1	11-08-2025 (Monday) 6:30 to 8:00 pm	Foundational principles of Quantum computing	Dr. Praveen Parthasarathi, Dr. HN National College of Engineering, Bangalore
Session 2	12-08-2025 (Tuesday) 6:30 to 8:00 pm	Quantum Gates and Circuits	Dr. H. Aswathaman, Department of Physics, Sapthagiri University, Bangalore
Session 3	13-08-2025 (Wednesday) 6:30 to 8:00 pm	Quantum Algorithms	Dr. S. Kathiresan, Group Director and Scientist (Retd.) DRDO
Session 4	14-08-2025 (Thursday) 6:30 to 8:00 pm	QKD Protocols: BB84, E91, and India's Indigenous Systems (DRDO & IIT Delhi)	Dr. Abha Khandelwal, Retd. Head Department of Computer Science, Hislop College, Nagpur & Founder Director, AACST
Session 5	16-08-2025 (Saturday) 6:30 to 8:00 pm	Application areas of Quantum Computing	Dr. Chitra Ravi Director Academics, Dept. of Computer Science, Maharani Lakshmi Ammanni College for Women Autonomous, Bangalore & AACST Bangalore Unit Event Coordinator

Event Overview:

The National Level Online Workshop on cutting edge technology, “**Quantum Quest: Principles, Security and Applications**” was organized by AACST Bangalore Unit successfully from 11th to 14th & 16th August 2025, 6:30 to 8:00 PM. The workshop attracted 64 participants, that included students, research scholars, faculty members and industry professionals across various states of India.

The workshop titled “Quantum Quest: Principles, Security and Applications” was designed with the goal of achieving the Outcomes such as Understanding basic Quantum computing concepts, learning about the basic building blocks quantum gates for building quantum circuits, quantum algorithms, quantum key distribution protocols for secure communication and also to be able to apply quantum computing to interdisciplinary problems.

The immersive workshop was a dynamic and thought-provoking event that brought together a diverse group of 64 brilliant participants - students, researchers, faculty members, professionals and enthusiastic learners from various fields from across states of India, in order to explore the cutting edge technology that is the future computing paradigm.

The workshop spanned for 5 days (11th to 14th and 16th August 2025) and included a series of technical sessions, and interactive discussions. The sessions were delivered by expert faculty members.

Key highlights of the workshop included:

- Basic sessions on quantum computing concepts
- Exploration of implementing quantum gates and circuits using simulators
- Exploration of Quantum algorithms and implementation through Qiskit tool

Discussions on the interdisciplinary applications of quantum computing in fields such as Drug Discovery and Healthcare, Sensors and Imaging, Finance, Climate modelling, simulations, industrial applications

Quiz was posted each day after the session for participants to assess their understanding of the session contents presented.

Number of participants: 64

Target Audience: Students/Research scholars/Faculty members/Heads of Departments/IT Professionals/Enthusiasts

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

Workshop Convener: Dr. Chitra Ravi, Director Academics, Maharani Lakshmi Ammanni College for Women Autonomous, Bangalore; Research Director, Cybersena (R&D) India Pvt. Ltd., Bangalore & AACST Bangalore Unit Event Coordinator

Resource persons:

1. Dr. Praveen Parthasarathi, Assistant Professor, Department of Physics, Dr. H N National College of Engineering, Bangalore
2. Dr. H Aswathaman, Associate Professor & HOD, Department of Sciences, Sapthagiri NPS University, Bangalore
3. Dr. S Kathiresan, Retd. Group Director and Scientist, DRDO, Bangalore
4. Dr. Abha Khandelwal, Retired Head, Dept of Computer Science, Hislop College, Nagpur & Founder Director, AACST
5. Dr. Chitra Ravi, Director Academics, Maharani Lakshmi Ammanni College for Women Autonomous, Bangalore

Session Chairpersons:

1. Dr. S Somasekara, Retd. Physicist, Bangalore
2. Dr. Arvind Kulkarni, Science Communicator, Bangalore
3. Dr. Vijayalakshmi A Lepakshi, Associate Professor, Department of Computer Science and Applications, Reva University, Bangalore
4. Dr. Melita Luke, Associate Professor, Principal In-charge, Yenapoya University Bangalore Campus
5. Dr. Manjula Sanjay, Professor & HOD, Dept. of MCA, Dayananda Sagar Academy of Technology and Management, Bangalore

Master of Ceremony:

1. Dr. Chitra Ravi
2. Dr. Abha Khandelwal

Valedictory function

Chief Guest :

Dr. Bhakti Patankar Rajvaidya, Assistant Professor, Department of Physics, G. H. Rasoni College of Engineering, Nagpur

Session 1: Foundational principles of Quantum Computing

1. Wave particle Duality
2. Heisenberg Uncertainty Principle
3. Qubit, Bloch sphere
4. Pauli Exclusion Principle
5. Superposition - Schrodinger Cat Experiment
6. Entanglement
7. Coherence and Decoherence
8. Quantum Measurement
9. Conclusion

Session 2: Quantum Gates and Circuits

1. Introduction
2. Pauli X, Y, Z gates
3. Hadamard gate
4. CNOT gate
5. Toffoli gate (CCNOT)
6. Half Adder on IBM Composer
7. Conclusion

Session 3: Quantum Algorithms

1. Introduction
2. Deutch Jozsa Algorithm
3. Shor's Algorithm
4. Grover's algorithm
5. Conclusion

Session 4: QKD Protocols

1. Introduction
2. BB84 protocol
3. E91 protocol
4. India's indigenous systems (DRDO and IIT Delhi)
5. Conclusion

Session 5: Applications of Quantum Computing

1. Introduction
2. Classical vs Quantum computing
3. Why Quantum computing?
4. Quantum Supremacy, Advantage, Utility
5. Proof of Work (PoW) in Blockchain
6. Quantum computers released
7. Applications of Quantum computing
8. Conclusion

Course Highlights:

1. Sessions led by expert faculty members
2. Exploration of cutting-edge technology
3. Course completion certificate
4. All session Video Recordings posted in Google Classroom.
5. At the end of each session, Assessment was conducted in the form of Quiz.

Course Outcomes:

1. Understand foundational key concepts of Quantum Mechanics
2. Understand quantum computing hardware – gates and circuits
3. Understand basic quantum computing algorithms for specific tasks
4. Demonstration of Usage of IBM Composer to understand gates and circuits
5. Understand applications of quantum computing in various domains.

Recorded Lectures: Were made available on Google Classroom for revision.

Assessment and Certification

Participants were assessed through quiz and required to maintain 75% attendance. Participation certificates were awarded to those meeting the criteria.

Valedictory Function

The valedictory function was organized on 16th August 2025. It was attended by all participants, resource persons and session chairpersons. The Chief Guest was Dr. Bhakti Patankar Rajvaidya, Assistant Professor, Department of Physics, G. H. Rasoni College of Engineering, Nagpur.

Dr. Chitra Ravi, Director Academics, Maharani Lakshmi Ammanni College for Women Autonomous, Bangalore; Research Director, Cybersena (R&D) India Pvt. Ltd, Bangalore, AACST Bangalore Unit Event Coordinator and Workshop Convener, presented a report on the 5 day National level online Workshop proceedings. About 4 participants gave their oral feedback about the various sessions of the workshop, shared their thoughts and reflections in the form of learnings and key takeaways requesting for conducting more such workshops in advanced levels. Participants have also given feedback through Google forms where they have rated each session as Excellent and Very Good.

Dr. Abha Khandelwal gave her closing remarks and attributed the success of the workshop to the convener of the workshop, all the resource persons and participants who were very enthusiastic and interactive. She appreciated all those who were involved in the workshop and asked them to share this knowledge forward and delve deeper into quantum technologies and to contribute to innovation.

Dr. Chitra Ravi, Workshop convener proposed the vote of thanks. She thanked the Chief Guest of the Valedictory function, Mentor of workshop for her continuous support and being the driving force, Chairpersons of all sessions, Resource persons of all sessions and all the participants for their active participation and engagement.

GALLERY



TEAM OF RESOURCE PERSONS

		
Dr. Praveen Parthasarathi Session 1	Dr. H Aswathaman Session 2	Dr. S Kathiresan Session 3
	 QUANTUM QUEST: PRINCIPLES, SECURITY AND APPLICATIONS	
Dr. Abha Khandelwal Session 4	11TH TO 14TH & 16TH AUGUST 2025	Dr. Chitra Ravi Session 5

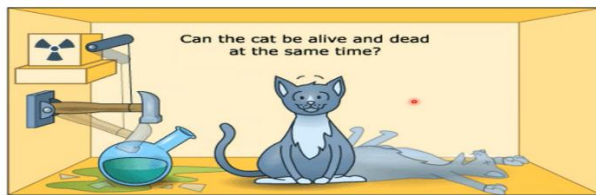
TEAM OF CHAIRPERSONS

 <p>Somasekara Sidiginamale</p>		
<p>Dr. S Somasekara Session 1</p>	<p>Dr. Arvind Kulkarni Session 2</p>	<p>Dr. Vijayalakshmi A Lepakshi Session 3</p>
		
<p>Dr. Melita Luke Session 4</p>	<p>11TH TO 14TH & 16TH AUGUST 2025</p>	<p>Dr. Manjula Sanjay Session 5</p>

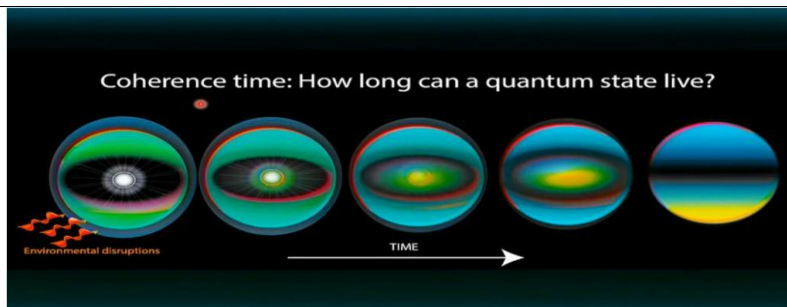
Session 1: Foundational Principles of Quantum Computing

Dr. Praveen Parthasarathi

Assistant Professor, Department of Physics
Dr. H N National College of Engineering, Bangalore



- Cat is both dead and alive at the same time before you open the box. **This is coherence or superposition state or quantum state.**
- Cat can be either dead or alive but not dead and alive when you look inside the box (analogous to measurement). **This is decoherence, you destroy superposition or the quantum state of the system.**



Session 2 : Quantum Gates and Circuits

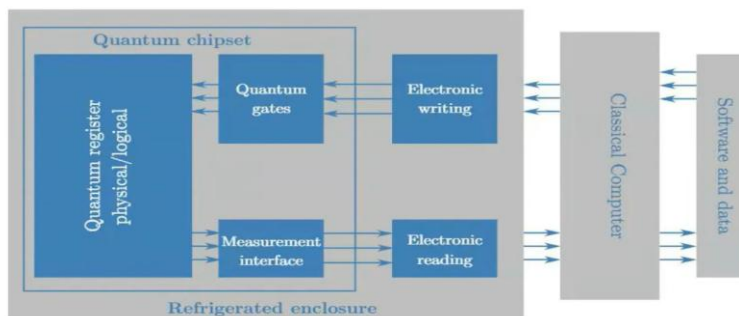
Dr. H Aswathaman

Associate Professor & HOD, Department of Sciences
Sapthagiri NPS University, Bangalore

The image shows a quantum circuit simulator interface on the left with a probability distribution graph. On the right, there is a mobile phone screen displaying a meeting app interface with participants like Swathi, CHITRA, Arvind, and Dr. Abha.



Quantum Hardware



Session 3: Quantum Algorithms

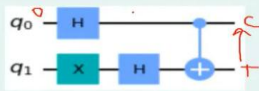
Dr. S Kathiresan

Retd. Group Director and Scientist, DRDO

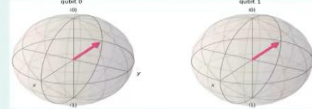
Phase Kickback

Kickback examples

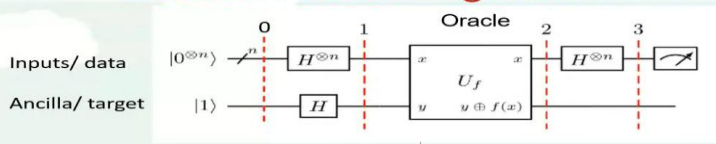
CNOT $|++\rangle = |++\rangle$
 CNOT $|+-\rangle = |--\rangle$
 CNOT $|-\rangle = |-\rangle$
 CNOT $|--\rangle = |+-\rangle$



$$\begin{aligned} \text{CNOT}(H \otimes H(|01\rangle)) &= \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 \\ 1 & 1 & -1 & -1 \end{bmatrix} \cdot \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \end{bmatrix} \\ &= \frac{1}{2} (|0\rangle|0\rangle - |0\rangle|1\rangle - |1\rangle|0\rangle + |1\rangle|1\rangle) \\ &= \frac{1}{\sqrt{2}} (|0\rangle - |1\rangle) \otimes \frac{1}{\sqrt{2}} (|0\rangle - |1\rangle) \\ &= |1-\rangle \end{aligned}$$



Deutsch-Jozsa Algorithm ...contd.



$|\psi_0\rangle = |0\rangle^{\otimes n} |1\rangle$

$|\psi_1\rangle = \frac{1}{\sqrt{2^n}} \sum_{x \in \{0,1\}^n} |x\rangle \left(\frac{|0\rangle - |1\rangle}{\sqrt{2}} \right)$

This is a **uniform superposition** of all n-bit strings on the data register, tensored with the ancilla in $|-\rangle = (|0\rangle - |1\rangle)/\sqrt{2}$ state

For a two-qubit state,

$$\begin{aligned} H^{\otimes 2}|0\rangle^{\otimes 2} &= \frac{1}{2} (|0\rangle + |1\rangle) (|0\rangle + |1\rangle) \\ &= \frac{1}{2} (|00\rangle + |01\rangle + |10\rangle + |11\rangle) \\ &= \frac{1}{2} \sum_{x \in \{0,1\}^2} |x\rangle \end{aligned}$$



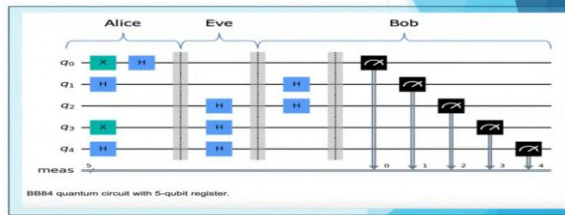
Session 4: QKD Protocols

Dr. Abha Khandelwal

Founder, AACST

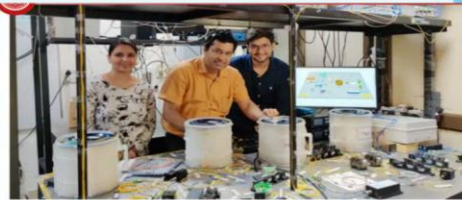
The First (QKD) Quantum Key Distribution Protocol BB84

- Quantum cryptography emerged in the 1980s with the BB84 protocol.
- “photons can transmit information.”** Building upon this work, Bennett and Brassard In 1984, proposed a method **BB84** for secure communication.
- It offers new ways to secure data against future threats from quantum computers.



Milestones in India's Quantum Secure Communication

1. Fiber-Based QKD (February 2022)
 Event: DRDO and IIT Delhi successfully demonstrated a **100 km quantum key distribution link** between **Vindhyachal and Prayagraj** using commercial-grade optical fiber.



It is noteworthy that the team led by Dr. Karsen, along with DRDO, has previously demonstrated the first Indian intercity quantum communication between Vindhyachal and Prayagraj in 2022, which was using more than 100 km commercial-grade underground dark optical fiber.

Impact: This milestone underlined the feasibility of long-distance, fiber-based quantum-secure channels



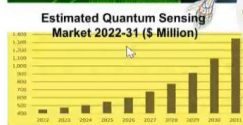
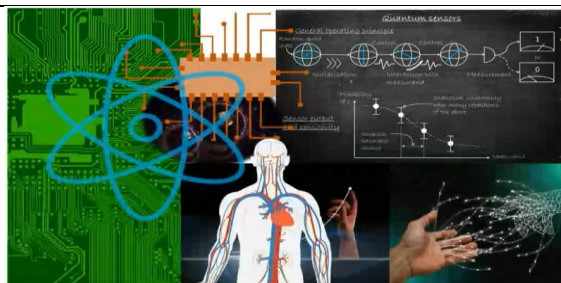
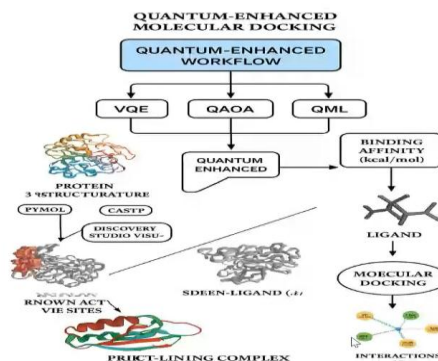
Session 5: Applications of Quantum Computing

Dr. Chitra Ravi

Director Academics, Department of Computer Science,
Maharani Lakshmi Ammanni College for Women Autonomous, Bangalore

Drug Discovery & Healthcare

- **Protein Folding**
- Protein function depends on **3D folding**. Misfolding leads to diseases (e.g., Alzheimer's).
- Quantum computers can explore the **vast conformational search space** much faster than classical systems.
- Quantum-enhanced machine learning can help predict stable protein structures.
- **Drug-Target Interaction**
- Drugs must bind precisely to biological targets (like enzymes or receptors).
- Quantum computing can model **binding sites** and optimize molecules for better **selectivity and efficacy**.
- VQE - Variational Quantum Eigensolver
- QAOA - Quantum Approximate Optimization Algorithm



- Ultra Low-level Detection
- Improved Imaging
- Efficient POC tools
- Effective IoT and AI

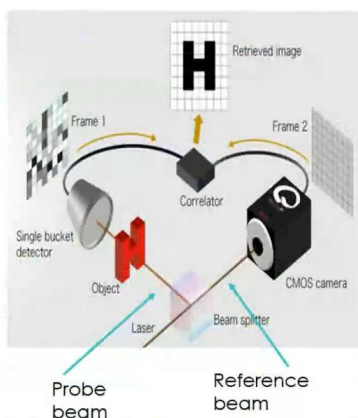
Personalized Diseases Management

Quantum sensors can detect magnetic fields and other physical quantities, with unprecedented spatial resolution and sensitivity, making them highly interesting for biomedical applications.



Quantum Imaging





- Uses entangled photon pairs to create images with higher resolution.
- Ghost Imaging is a technique where an image is formed using correlations between two light beams.
- Two beams of light are generated, typically one is a probe beam that passes through or reflects off the object, and the other is a reference beam that does not interact with the object.
- A detector captures the total light intensity after the probe beam has interacted with the object. However, this detector does not record spatial information about where the light comes from.
- A second detector measures the reference beam, which carries spatial information but has never interacted with the object.
- By correlating the data from both detectors, an image of the object can be reconstructed, even though one of the beams never directly interacted with the object.



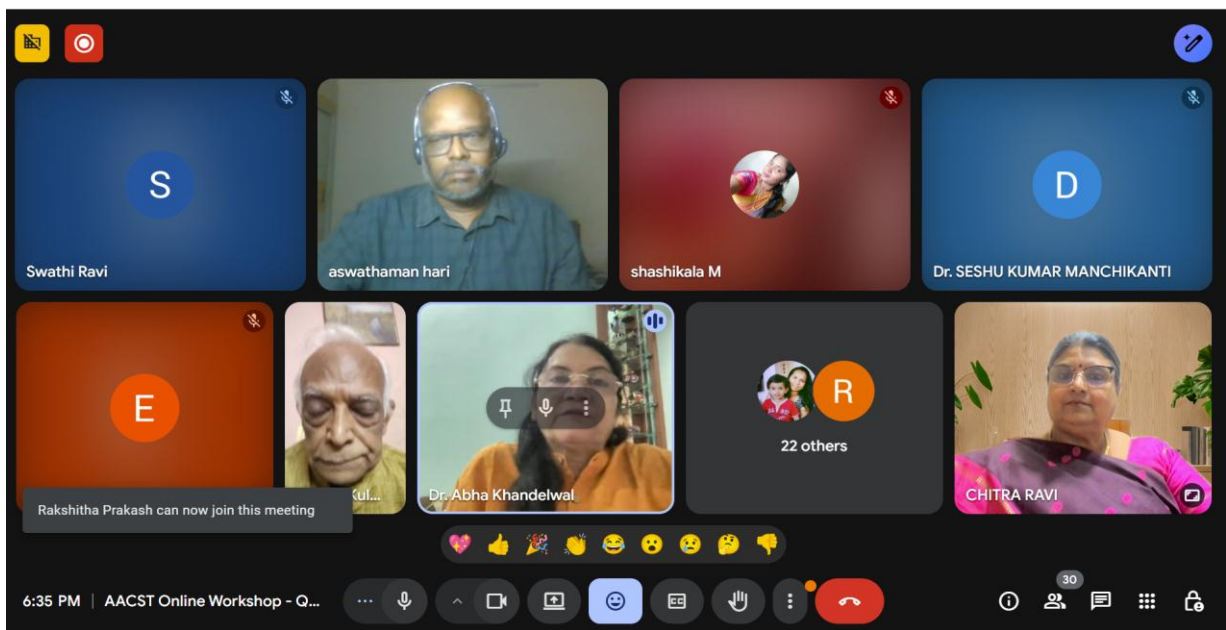
VALEDICTORY FUNCTION - 16TH AUGUST 2025 8:00 TO 8:30 PM

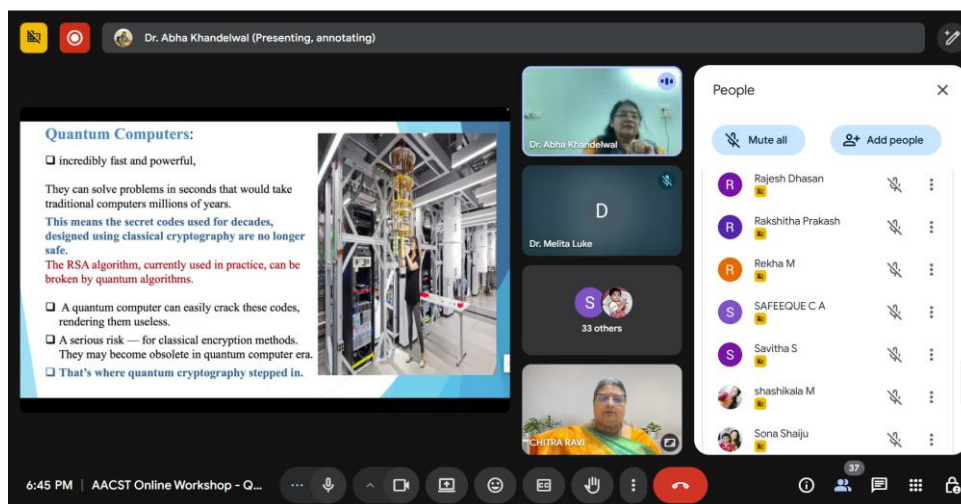
		
Dr. Chitra Ravi Workshop Convener (Report presentation)	Dr. Abha Khandelwal - Workshop Mentor (Closing Remarks)	Dr. Bhakti Patankar Rajvaidya (Chief Guest Address)

FEEDBACK FROM PARTICIPANTS

	
C Namrata Mahendar (Dr. Ambedkar University, Aurangabad)	Dr. Sreeparna Chakraborti (Kristu Jayanti University, Bangalore)
	
Vinayak Gupta (HSBC Bank, Bangalore)	Ms. Rakshitha Prakash (Christ University, Bangalore)

PARTICIPANTS OF WORKSHOP





Conclusion:

The 5-day national level online workshop on "**Quantum Quest: Principles, Security and Applications**" has been an enriching experience, fostering an in-depth understanding of foundational principles of quantum computing, quantum gates and circuits, quantum algorithms, quantum key distribution protocols such as BB84 and E91 and India's indigenous systems. (IIT Delhi and DRDO), and applications of Quantum computing in the fields of Drug Discovery, Healthcare, Genomics, Smart Agriculture, Sensors and Imaging, Climate modelling, Quantum Finance, Space exploration, Simulation, Optimization, etc.

Key takeaways include:

1. **Foundational Knowledge:** Attendees gained a comprehensive grasp of the underlying foundational principles of quantum mechanics.
1. **Hands-on Learning:** IBM Composer was demonstrated to try out quantum gates and circuits experiments.
2. **Challenges:** Knowledge of Qiskit programming required to implement quantum algorithms, basic knowledge of Linear Algebra required to understand the design of circuits to perform certain operations.
3. **Future Directions:** The workshop served as a catalyst for future research, collaboration, and exploration in quantum technologies and their applications

In conclusion, the workshop has empowered participants with basic understanding of quantum computing principles, security and applications. The knowledge and skills acquired during these 5 days will equip students, researchers, faculty members and professionals, to explore further and contribute meaningfully to the paradigm shift from classical to quantum computing.

Report Prepared By:

DR. CHITRA RAVI

RESEARCH DIRECTOR, CYBERSENA (R&D) INDIA PVT. LTD., BANGALORE

AACST BANGALORE UNIT EVENT COORDINATOR and WORKSHOP CONVENER