



Dr. AMBEDKAR INSTITUTE OF TECHNOLOGY

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Report on

One-Day Seminar on Quantum Computing: Fundamentals and its Emerging Trends

Organized by

Department of Physics
School of Applied Sciences and Humanities
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Bengaluru - 56

One-Day Seminar on Quantum Computing: Fundamentals and its Emerging Trends

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Department of Physics under School of Applied Sciences and Humanities organized one-day seminar on Quantum Computing: Fundamentals and its Emerging Trends. Quantum computing has the potential to revolutionize the way we think about computing and information processing. The quantum computers can outperform classical computers in certain specialized tasks. New applications are being proposed in a variety of fields. Participants will learn about qubits and gating operations, construct quantum circuits. The primary objective of this seminar is to provide participants with a comprehensive understanding of the various fundamentals, applications, challenges and research areas in Quantum Computing.

Objectives:

The key objectives of the seminar are:

- To disseminate of the knowledge of Integrity of Quantum computing and machine learning among researchers, and academicians.
- To provide conceptual understanding of how Quantum Computing technology can be used in various fields.
- Train the young minds in the field of quantum computing to fulfill the growing Necessity.
- To discuss the status of the quantum computing development and research work in India and across the world.
- To motivate the participants to take up advance research in Quantum Computing.
- To update the present scenario in Quantum Computing fundamentals and emerging trends.

The number of participants registered were 87; which includes online and spot registration, out of which faculties - 16; research scholars and students from different streams - 71.

The inaugural function started at 9.30 am on a graceful note with an invocation song rendered by Ms. Shruthi K.

This was followed by a warm welcome to the dignitaries, delivered by **Prof. R. Murali**, Head of the School (HoS), School of Applied Sciences and Humanities.

The inauguration was then carried out in a meaningful way, with the dignitaries symbolically watering the plant—signifying growth, knowledge, and sustainability.

We were then addressed by our Vice Principal, **Prof. K.N Anuradha**, who inspired the gathering with her words of encouragement and guidance.

Following this, **Prof. L. M. Patnaik**, Senior Research Adviser at Dr. AIT, shared his valuable technical insights and addressed the gathering, setting the right academic tone for the seminar.

The formal function concluded with the Vote of Thanks, delivered by **Prof. Jambunath Baligar**, Head of the Program (HoP), Department of Physics, who expressed gratitude to all the dignitaries, faculty, and participants.

Session – I:

With the formal inaugural session complete, we then moved on to the seminar. The first speaker of the day was **Dr. Chandrashekar**, Assistant Professor at Indian Institute of Science (IISc), who delivered his talk on ***The Promise of Quantum Computers*** at 10 am.

We had a very insightful session by Dr. Chandrashekar. In his talk, he highlighted how quantum computing, by harnessing the principles of quantum mechanics, can address problems that even the most powerful classical computers cannot manage efficiently.

He walked us through some possible use cases where quantum computers are expected to make a significant impact. What stood out was his reminder that these machines are not here to replace classical computers but to complement them by opening up new possibilities.

Dr. Chandrashekar also shared the current state of research and the platforms being explored—superconducting circuits, trapped ions, ultra-cold atoms, and photons. As we heard, each platform comes with unique strengths as well as serious challenges. The central hurdle remains scaling up the number of qubits and protecting their fragile states from environmental disturbances.

The talk was interesting when he spoke about the strategies researchers are experimenting with—like error correction and hardware optimization—to overcome these obstacles. It gave us a sense of how global the effort is, and how much promise lies ahead.

Finally, he brought the discussion closer home by outlining the **National Quantum Mission**, launched by the Department of Science and Technology. It was

encouraging to hear that India is investing in this area to strengthen indigenous capabilities and contribute to the global quantum ecosystem.

In summary, this session gave us both a reality check and a sense of excitement: while the challenges in building large-scale quantum computers are immense, the opportunities they promise are even greater. Personally, I came away with a deeper appreciation of the field and a sense of pride that our country is actively part of this journey.

Session – II:

With that enriching start, we then moved on to the second session by **Ms. Shikha Mehrotra**, from CDAC, which was very engaging on **Beyond Classical: Entering the World of Quantum Computing**. In her talk, she highlighted how classical computers, despite being the backbone of technological progress for decades, struggle with certain intractable problems in cryptography, optimization, and material science. She explained how quantum computing, by harnessing the principles of superposition, entanglement, and quantum parallelism, offers possibilities far beyond the reach of classical computation.

She guided us through the fundamental differences between classical and quantum computing, illustrating why the shift is not merely incremental but truly transformational. The discussion also introduced breakthrough algorithms like Grover's Search, which demonstrated the unique efficiency of quantum systems in solving specific types of problems.

Ms. Mehrotra did not overlook the real-world challenges either. She pointed out the engineering difficulties in building scalable quantum hardware, including decoherence and error correction, and emphasized the global race where leading nations and technology giants are competing to achieve quantum advantage.

What stood out was her ability to make the concepts intuitive and accessible, allowing participants to grasp not just the theory but also the potential applications of quantum computing. She highlighted its relevance in domains such as cybersecurity, drug discovery, logistics, and material science, stressing how these advances could drive innovation in the coming decades.

In conclusion, the session gave us a balanced perspective --- an appreciation of the enormous opportunities quantum computing holds, while also acknowledging the significant hurdles that must be overcome. Participants came away with a deeper understanding of why quantum computing is considered one of the most profound shifts

in the history of computation and why global collaboration and sustained research are key to its future.

Session – III:

The momentum continued with the third session, by **Dr. Divyansh Shrimali**, from CDAC **on Quantum Computing: Foundations and Emerging trends**, where we explored emerging trends and forward-looking perspectives in this exciting field.

The session started with a clear explanation of the fundamentals—how quantum computers differ from classical ones by working with qubits instead of bits, and by using principles like superposition, entanglement, and coherence. This gave us a solid base to follow the rest of the discussion.

Dr. Shrimali then introduced us to quantum gates and circuits, and gradually moved to some of the most well-known quantum algorithms, such as **Shor's factorization algorithm** and **Grover's search algorithm**.

Especially striking on how he linked these algorithms to real-world applications, particularly in areas like cryptography, optimization, and scientific simulation.

The talk then shifted towards the current state of quantum hardware. We got a realistic picture of both the remarkable progress made so far and the serious challenges that remain, especially in what he called the **NISQ era**—the Noisy Intermediate-Scale Quantum stage where today's machines operate.

Looking ahead, he also spoke about emerging trends shaping the field. Among them were **hybrid quantum-classical approaches**, **quantum error correction**, and the expanding scope of applications in diverse areas such as finance, material science, and logistics. I found this part particularly exciting, as it showed us how quantum computing is beginning to move from theory toward practical, real-world impact.

Finally, the session ended on a thoughtful note, encouraging us to balance high expectations with realism, and to keep an eye on the promising directions this field is heading towards.

Overall, this talk not only deepened our understanding of the foundations of quantum computing but also broadened our perspective on where the field is going. Personally, I came away with a sense of both clarity and curiosity—the clarity of fundamentals and the curiosity to see how these emerging trends unfold in the years to come.

With this, we conclude the report on 'One-Day Seminar on Quantum Computing: Fundamentals and its Emerging Trends' sessions. Each of the talks offered us valuable

insights into the fascinating world of Quantum Computing, from its promise to this foundations and emerging trends.

We, the coordinators sincerely thank all the speakers for their active contributions. We extend our deepest gratitude to the trustee members for their generous financial support, which was vital to the seminar's execution.

Outcomes:

At the end of the seminar, the participants will be able to describe the differences between quantum computing and classical computing. They will be able to know about the Quantum Mechanics and Quantum Gates, circuits. They will be able to describe the current trend of quantum computing development in the industry and academia and also to describe about the Qubit Gates and Quantum Cryptography.

We extend our heartfelt gratitude to **Prof. L.M Patnaik**, Senior Research Adviser at Dr. AIT, whose unwavering support and expertise were instrumental in making this seminar a reality. His pivotal role in identifying and engaging esteemed resource persons was crucial to the event's success. We thank Chief Academic Mentor **Prof. N. C. Shivaprakash**, for his guidance and motivation.

We also sincerely thank the Principal **Dr. M. N. Thippeswamy** and Vice Principal, **Prof. K. N. Anuradha**, for their valuable inputs and guidance throughout the process.

Lastly, we thank the **Prof. R. Murali**, HoS and **Prof. Jambunath Baligar**, HoP for their steadfast support and contribution to the event's accomplishment.

Finally, we would like to end by stating a quote:

“Classical computers can tell you the answer but quantum computers can show you possibilities.”

Coordinators

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Dr. Latha Rani N.

Dr. Mohamed Zikriya