

**AICTE Training and Learning Academy  
(ATAL) Sponsored One-week Faculty  
Development Program on  
Quantum Photonics, Computing and  
Communications  
18<sup>th</sup>-23<sup>rd</sup> Dec. 2023**

**R. V. College of Engineering, Bengaluru**

RV College of Engineering (RVCE) is a prestigious self-financing engineering college established in 1963. It is affiliated with Visvesvaraya Technological University (VTU) Belagavi and operated by Rashtreeya Sikshana Samithi Trust (RSST). RVCE offers 15 Bachelor's and 14 Master's programs with research centers in all departments. The institution's vision emphasizes quality technical education, interdisciplinary research, innovation and sustainable technology. RVCE has an impressive publication record with over 1500 national and international journal and conference publications. It has filed 62 patents, published 53 patents, and been granted 22 patents. The institution has completed sponsored research and consultancy projects worth ₹16.0 crores in the last three years. Additionally, RVCE has established 8 Centers of Competence and 18 Centers of Excellence in various domains.

**CIRQuIT (Centre for Interdisciplinary Research  
in Quantum Information and Technology)**

This CoE at RVCE was started with the vision to inspire young minds to take up research in the Quantum Computing field and to develop viable solutions to real-world problems. Some of the activities of the CoE includes;

1. To increase awareness and spread knowledge about quantum computing and related concepts.
2. To conduct research in areas specific to:
  - a. Quantum Algorithms
  - b. Quantum Machine Learning
  - c. Quantum Annealing Optimization
  - d. Quantum Cryptography
  - e. Quantum Hardware

3. Utilizing open-source quantum computing tools like IBM Qiskit, Cirq, Tensorflow Quantum, DWave Ocean SDK, PennyLane, and other related software.

The CIRQuIT has successfully conducted many internship programs, National-level workshops, and ATAL FDPs for faculty and students from various engineering disciplines. The group collaborates with IBM to train and utilize their open-source quantum computing toolkit QisKit

**Information Science & Engg.**

The Department of ISE has faculty members working in the areas Artificial Intelligence, Internet of Things, Cloud Computing. The Department also has a research centre recognized by VTU started in the year 2011. The Research Center provides a vibrant academic ambience hosting more than 39 research scholars both internal and external. The center is affiliated to VTU, Belagavi under the Department of ISE, RVCE. The center has eminent faculty members who are guiding Ph.D. scholars in advanced areas of Information Sciences like Artificial Intelligence, Natural Language Processing, Cyber Security, Data Science, Image Processing, Internet of Things and Cloud computing.

**About the workshop**

Quantum computing is an application of superposition and entanglement quantum-mechanical phenomena to perform computation, as proposed by Richard Feynman in 1982. As said and done, quantum computing is a revolutionary technology that leverages the bizarre characteristics of quantum mechanics to solve specific problems significantly faster than classical computing technologies.

The workshop covers essential basics of quantum photonics, computing, information theory aspects, hardware technologies, algorithms, and implementations, followed by demonstrations of the working over the some of the popular simulators on quantum computing IBM QisKit, QSim, and NetSquid Simulators.



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(Autonomous Institution Affiliated to VTU, Belagavi)  
Bengaluru- 560059, Karnataka.**

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**&**

**Dept. of Information Science & Engg.**

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## Workshop Content

- **Basics of Quantum Photonics:** Generation, Emission, Transmission, Switching, Amplification, and, in general, covers the engineering and coherent control of quantum systems, i.e. down to the single photon level.
- **Quantum Mechanics:** Mathematical description of the motion and interaction of subatomic particles, incorporating the concepts of quantization of energy, wave-particle duality, the uncertainty principle, and the correspondence principle.
- **Essential Mathematics for Quantum Computing:** Mathematical formulation of Quantum Mechanics
- **Basics of Quantum Computing:** From Bits to Qubits: Dirac Notation, Quantum measurement, Bloch Sphere, Building Basic Quantum Circuits & Quantum Entanglement: Basic Single Qubit and Two-Qubit Gates, Multipartite Quantum States, Quantum Operations, Bell States
- **Quantum Hardware and Devices:** Superconducting circuits, quantum dots, trapped ions, Quantum Mechanics Realizations etc.
- **Quantum Communications:** Quantum Key Distribution for Quantum Cryptography and Free-space quantum communications

## Resource Persons:

- Professors from IISc, PRL, IMS, IISER, and RVCE
- Quantum Engineers from Industry
- Senior Researchers of CIRQUIT

## Advisory Committee:

- Dr. K.N. Subramanya, Principal, RVCE
- Dr. Geetha K S., Vice-Principal, RVCE

## Coordinator:

Dr. B. Sathish Babu, Professor & HoD, Dept. of AIML, RV College of Engineering

## Co-coordinator:

Dr. Sagar B M, Professor & HoD, Dept. of ISE, RV College of Engineering

## Organizing Committee:

Dr. Tribikram Gupta, Asst. Professor, Dept. of Physics, RVCE

Mr. Somesh Nandi, Asst. Professor, Dept. of AIML, RVCE

Mr. Venugopal K, Asst. Professor, Dept. of Maths, RVCE

## Address for Correspondence:

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## Objectives of the workshop:

- Give the required photonics basics for developing quantum hardware and devices
- Provide the necessary Physics and Mathematical concepts of Quantum Computing, which helps the participants to understand the research literature
- Given the working of the design of selected quantum algorithms, including quantum crypto algorithms and search algorithms, participants may develop their applications using them.
- Appraise the participants for working on the quantum communication Systems using quantum photonics.
- To appraise the working of quantum mechanics and related concepts.
- To build quantum circuits using quantum bits and execute over quantum computers/simulators.



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## 6 Days FDP on Quantum Photonics, Computing and Communications

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
9:00 – 9:30 Inauguration					
9:30 – 12:00 Session 1  Introduction to Quantum Photonics  Dr. Shouvik Datta  Professor Indian Institute of Science Education and Research - Pune	9:30 – 12:00 Session 3  Quantum Photonics Hardware  Mr. Abeer Vaishnav  Quantum Device Engineer Atlantic Quantum	9:30 – 12:00 Session 5  Quantum Communication  Mr.Rohit Ramakrishnan  Researcher Indian Institute of Science	9:30 – 12:00 Session 7  Free Space Quantum Communication  Dr. R.P.Singh  Physical Research Laboratory - Ahmedabad	10:00 – 12:00  Visit to Industry	9:30 – 12:00 Session 10  Session on LifeSkills  Art of Living
12:00 – 1:00 Article 1 Discussion Topic: OD-2D heterostructure for making very large quantum registers using 'itinerant' Bose-Einstein condensate of excitons  <a href="https://doi.org/10.1016/j.mtelec.2021.100039">https://doi.org/10.1016/j.mtelec.2021.100039</a>	12:00 – 1:00 Article 2 Discussion Topic: Role of Bell-CHSH violation and local filtering in quantum key distribution  <a href="https://doi.org/10.1016/j.physleta.2021.127158">https://doi.org/10.1016/j.physleta.2021.127158</a>	12:00 – 1:00 Article 3 Discussion Topic: Qudit-Teleportation for photons with linear optics  <a href="https://doi.org/10.1103/PhysRevA.100.032330">https://doi.org/10.1103/PhysRevA.100.032330</a>	12:00 – 1:00 Article 4 Discuson Topic: Experimental Side Channel Analysis of BB84 QKD Source  <a href="https://doi.org/10.1109/JQE.2021.3111332">10.1109/JQE.2021.3111332</a>		12:00 – 1:00  Refelection Journal
1:00 – 2:00 Lunch	1:00 – 2:00 Lunch	1:00 – 2:00 Lunch	1:00 – 2:00 Lunch	1:00 – 2:00 Lunch	
2:00 – 4:30 Session 2  Advance Quantum Photonics  Dr T Srinivas  Professor , ECE Indian Institute of Science - Bangalore	2:00 – 4:30 Session 4  Quantum Dots  Dr. Preeta Sharan  Professor, Dept. of ECE, TOCE Bangalore	2:00 – 4:30 Session 6  Quantum Mechanics  Dr. Tribikram Gupta  Dept. of Physics, RVCE, Bangalore	2:00 – 4:30 Session 8  Mathematics for Quantum Computing  Dr. Venugopal K  Dept. of Mathematics RVCE Bangalore	2:00 – 4:30 Session 9  QKD Fundamentals  Dr. Sibasish Ghosh  The Institute of Mathematical Sciences - Chennai	2:00 – 4:00  MCQ, Feedback and Interactions
4:30 – 5:30  Quantum Simulator Handson Session – I  CIRQUIT Researchers	4:30 – 5:30  Quantum Simulator Handson Session– II  CIRQUIT Researchers	4:30 – 5:30  CADFEM Quantum Photonics Simulator  Sushruth Choudhary Application Engineer CADFEM -India	4:30 – 5:30  CADFEM Quantum Photonics Simulator  Sushruth Choudhary Application Engineer CADFEM -India	4:30 – 5:30  Quantum Simulator Handson Session– III  CIRQUIT Researchers	4:00 – 5:00  Valedictory