

About IIT Kharagpur



Kharagpur - a dusty town tucked away in the eastern corner of India, famous until 1950 as home to the longest railway platform in the world - became the nursery where the seed of the IIT system was planted in 1951. IIT Kharagpur started its journey in the old Hijli Detention Camp in Eastern India, where some of the country's great freedom fighters toiled and sacrificed their lives for India's independence. Spurred by the success of IIT Kharagpur, four younger IITs sprouted around the country in the two following decades, and from these five came thousands of IITians, the brand ambassadors of modern India. It was the success of this one institution at Kharagpur that wrote India's technological odyssey.

The Institute takes pride in its relentless effort to provide the best platform for both education as well as research in the areas of science and technology, infrastructure designs, entrepreneurship, law, management, and medical science and technology. IITKGP is not just the place to study technology, it is the place where students are taught to dream about the future of technology and beam across disciplines, making differences enough to change the world.

Program Features/ Structure

Classroom lectures – 80%
Numerical/ Problem solving, Case study and Activity – 10%
Tutorial – 10%

Program Schedule and Venue

1 week
24 – 28 July 2023
(2:30 PM – 6:30 PM)
S. N Bose Auditorium
IIT Kharagpur

Last day of Registration

20
July 2023

Who will benefit (Eligibility)

you are an advanced B. Tech, B. S, MSc, MTech, PhD Scholar in Physics and Master degree holder teachers at Engineering Colleges / Degree colleges

Program Fee

Nil

Accommodation & Food

No accommodation will be provided
Food you can get from the staff canteen on chargeable basis.

How to Apply

Use the link: to apply ONLINE

https://docs.google.com/forms/d/e/1FAIpQLSFH5xDWxICAkPBCpR2cqrH5B8llsBDPdR_IGHTE5nD7dpDygt/viewform?usp=pp_url

Contact Us

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Short course on Quantum Information & Computation



Department of Physics &
Advance Technology Development Centre
Indian Institute of Technology Kharagpur
2023

1 Week
24 – 28 July 2023

Introduction / Overview

Quantum information and computation is a field of study that combines the principles of quantum mechanics, classical information theory and the knowledge of computer science to explore the fundamental aspects of information and develop new computational paradigms. It harnesses the unique properties of quantum systems, such as superposition, entanglement, non-locality to process and transmit information in ways that are fundamentally different from the existing classical protocols. It encompasses a wide range of applications, including Shor's algorithm for prime factorization, super dense coding, secure quantum key distribution, and quantum teleportation. Other areas of focus include quantum sensing, Grover's search algorithm, quantum error correction, quantum machine learning, and quantum simulation. Quantum information processing benefits from precise control and manipulation of subatomic particles. Various physical systems, such as atoms, ions, photons, and superconducting circuits, serve as the basic building blocks for realizing these phenomena. Present state of art experiments made quantum computation possible in real life.

Program Objectives

This short course would introduce the basics building blocks of quantum formalism towards the developments of quantum information and computation. The fundamental concepts like quantum gates, quantum algorithm, classical information transmission with and without security, teleportation will be introduced. The discussion on 2022 Physics Nobel prize, on the experimental demonstration of non-locality will help the students to understand the foundation of quantum mechanics. This course can provide individuals with valuable knowledge, career opportunities, and a deeper understanding of the quantum world and can actively contribute to the cutting-edge research and innovations. It equips them with skills that are increasingly in demand in various industries, while also fostering a sense of intellectual growth and exploration.

What you will learn

Program Content

- 1) Basic formalism of Quantum Mechanics & Quantum Computations
 - Quantum States (Pure & Mixed), Qubit, Qutrit
 - Bipartite States & Entanglement
 - Quantum Gates, Quantum Algorithms
 - Simple Quantum Circuit
- 2) Computing: from Classical to Quantum
 - Shannon's Information Theory
 - Classical codes
- 3) Introduction to Quantum Information and Communication
 - Holevo bounds, communication complexity
 - Computational complexity classical and quantum
- 4) Violation of local-realism – Bell inequality
 - Local hidden variable model
- 5) Use of Entanglement: Quantum Communication
 - Dense Coding, probabilistic and deterministic, multiple senders to single and two receivers
 - Quantum cryptography, BB84, Ekert'91
 - Idea of device independent protocol
 - Quantum Teleportation, Repeater
- 6) Quantum optical experiments: From quantum foundations to quantum information and computation
 - Generations, manipulation, and detection of quantum optical states
 - Quantum optical implementation of quantum communication
 - Quantum computational advantage using quantum optical systems.

About the Faculty

Tamoghna Das

Assistant Professor, Department of Physics, IIT Kharagpur

Expertise: Quantum Information and Computation, Quantum communication networks, Bell non-locality

Syamsundar De

Assistant Professor, Advance Technology Development Centre, IIT Kharagpur

Expertise: Photonic quantum information technologies, experimental quantum optics, light-matter interaction, lasers, nonlinear optics, and integrated photonics

Bibhas Adhikari

Associate Professor, Department of Mathematics, IIT Kharagpur

Expertise: Applied linear algebra, Complex networks, Quantum Information Theory

Sonjoy Majumder

Professor, Department of Physics, IIT Kharagpur

Expertise: Light-matter interaction, Vortex beam, Ultra-Cold Atoms and Molecules, Variational Quantum Algorithm

Sudebkumar Prasant Pal

Professor, Department of Computer Science and Engineering, IIT Kharagpur

Expertise: Quantum Information Processing and Protocols, Graphs and Hypergraphs