

**IIT Mandi**  
**Proposal for a New Course**

**Course Name: A Short Introduction to Quantum Technologies**

**Course Number:** PH 591

**Credits:** (1-0-0-1)

**Prerequisites:** Any first level course on Quantum Mechanics (PH513 or PH501)

**Intended for:** M.Sc., Ph.D., I-Ph.D., B.Tech( 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> Year).

**Distribution:** Elective for I-Ph.D., Ph.D., M.Sc., B.Tech (2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> Year).

**Preamble:** Development of solid-state transistor and high storage memory devices has led to the unprecedented fast growth of the human civilization. This technology is based on the principles of quantum mechanics and can be termed as Quantum 1.0. Now, a second revolution in the quantum technology is on the card, which promises more precise, advanced, and effective methods for the transfer of information, sensing and computation. This course will familiarize the students with the key concepts of new quantum technology 'Quantum 2.0'.

**Course Outline:** The course will start with the revision of basic concepts of quantum mechanics and operation and measurement of quantum bits. The other modules will cover the basic concepts of Quantum Metrology and Sensing, Quantum Communication and Quantum Computation.

**Modules:**

1. **Introduction:** Essential concepts in Quantum Mechanics, The Qubit, Bloch sphere; Single qubit operations and measurements. [3]
2. **Quantum Metrology:** Role of quantum effects (Josephson Effect, Squeezed state, Quantum Entanglement) in obtaining higher precision. [3]
3. **Quantum Communication:** Classical and Quantum information processing, Cryptography, Quantum Key Distribution. [4]
4. **Quantum Computations:** Quantum logic gates and circuits, Quantum Fourier Transform, Shor's algorithm, Grover's search algorithm. [4]

**Books and References:**

1. 'Quantum Computation and Quantum Information', Michael A. Nielsen and Issac L. Chuang; Cambridge University Press, Cambridge, UK (2010).
2. 'Lecture Notes on Quantum Information and Computation', by John Preskill, California Institute of Technology (1998).
3. 'Quantum bits with Josephson Junction', G. Wendin and V.S. Shumeiko, Low Temperature Physics. 33, 724 (2007)

**Similarity Content Declaration with Existing Courses:**

Sl. No.	Course code	Similarity content	Percentage
1)	N/A	N/A	N/A

**Proposed by:** Dr. C. S. Yadav

**School:** School of Physical Sciences (SPS)

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Recommended/Not Recommended, with Comments:

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Chairman, CPC

Date: \_\_\_\_\_

Approved / Not Approved

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Date: \_\_\_\_\_

Chairman, Senate