

**I SEMESTER 2023 - 2024**

**COURSE HANDOUT**

Date:11-08-2023

In addition to part I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

***Course No.* :** BITS F386

***Course Title*:** Introduction to Quantum Information and Computation

***Instructor‑in‑charge*:** T S L Radhika

**Scope & Objective of the course:** This course is an elementary introduction to a new andfrontier multidisciplinary field of quantum computation and quantum information. This subject is of common interest to physics, computer science, mathematics, and engineering students. It introduces the concept of information in a physical sense and how quantum physics becomes important in its realization. The course introduces the basic ideas of quantum mechanics relevant to the presentation of information in terms of qubits and how this information can be processed (computed) and transmitted.

**Text Book:** Quantum Computation and Quantum Information, M A Nielsen and I L Chuang, CAMBRIDGE, 2013.

**Reference Books:**

1. Principles of Quantum Computation and Information, V.1, Benenti, Casati and Strini, World Scientific, 2004.
2. Online lecture notes by Mark Oskin: <https://homes.cs.washington.edu/~oskin/quantum-notes.pdf>
3. Online lecture notes by John Preskill:

[http://www.theory.caltech.edu/people/preskill/ph229](http://www.theory.caltech.edu/people/preskill/ph229/)/

**Course Plan:**

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| **Lecture Number** | **Lecture Objectives** | **Topics to be covered** | **Chapter in the**  **Text Book** |
| 1-3 | To learn the concepts of Quantum Computing | Fundamental concepts, Quantum bits, Quantum information | 1.1, 1.2, 1.6, |
| 4-10 | To study the pre-requisites and fundamentals of Quantum Mechanics | Quantum computation, Linear algebra, Postulates of Quantum Mechanics | 1.3 (1.3.1-1.3.3), 2.1, 2.2 |
| 11-17 | To understand Quantum circuits | Quantum Gates: single qubit, multiple qubit gates, Controlled gates, Universal Gates, Measurement, Bell states. | 1.3 (1.3.4-1.3.6), Ch 4 |
| 18-23 | To learn Quantum Algorithms | Quantum Teleportation, Quantum parallelism, Deutsch's algorithm, Deutsch-Jozsa algorithm | 1.3.7, 1.4 |
| 24-28 | To study Quantum Fourier Transform | Quantum Fourier Transform and its Applications | Ch 5 |
| 29-32 | To learn Quantum algorithms (contd.) | Shor's Algorithm, Grover's Algorithm | Oskin, Lecture Notes |
| 33-36 | To understand Quantum noise, Error correction | Quantum operations, Error correction, Coding | 8.2, 8.3, 10.1, 10.3, 10.4 |
| 37-40 | To study Quantum Cryptography | Quantum Cryptography | 12.6 |

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| **Evaluation Scheme:** | |  |  |  |  |
| **EC** | **Evaluation** | **Duration** | **Weightage** | **Date, Time** | **Remarks** |
| **No.** | **Component** |  | **(%)** |  |  |
| 1 | Assignment -1 |  | 10 | Take Home | Open Book |
| 2 | Assignment -2 |  | 10 | Take Home | Open Book |
| 3 | Project and Viva |  | 15 |  | Open Book |
| 3 | Mid-Sem |  | 30 | 11/10 - 4.00 - 5.30PM |  |
|  |  |  |  |  | Closed Book |
| 4 | Comprehensive |  | 35 | 13/12 AN | Closed Book |

**Chamber consultation hour:** To be announced in the class.

**Make-up Policy**: Make-up will be given only for genuine cases, and prior permission must be obtained from the I/C.

**Notices:** The notices concerning this course will be displayed on the CMS only.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester, and no type of academic dishonesty is acceptable.

**Instructor-in-Charge**

**BITS F386**