NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech Computer Science & Engineering		
Course Title	Quantum Computing		
Course Code	CSHO19		
Course Code of Pre-requisite subject(s)	NIL	No. of Credits	4 (3-1-0-4)
Session	JULY 2022	Section (if Applicable)	III-year A & B & IV-year A & B
Name of Faculty	SELVAM. D (Research Scholar)	Department	Computer Science and Engineering
Official Email	406118053@nitt.edu	Telephone No.	9790686936
Name of Course Coordinator(s) (if, applicable)	NA		
Official E-mail	-		
Course Type (please tick appropriately)	Elective course (HONOR)		

Syllabus (approved in BoS)

Refer the Link:
https://www.nitt.edu/home/academics/curriculum/B.Tech-CSE-2020.pdf (Page Number 31)

COURSE OVERVIEW

This course indroduce the basic of Quantum computing.It is a barach of physics quantum and computer science that deals with superposition, entagelement and inference of Computational basis states in Quantum atom. Quantum Computing deals with Quantum mechansum, Quantum information and error correction of Quantum application.This course introduces the fundamental concept of Quantum operations, Quantum information theory and apply various security application in Quantum Computing.

COURSE OBJECTIVES

- To understand the principles of quantum computation and mechanics
- To learn about the operators involved in Quantum computing and their applications
- To study the information theory aspects of quantum computing
- To explore the various error corrections available for quantum computing
- To comprehend the applications of quantum computing to information theory and cryptography

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)

Upon completion of the course, the students will be able to	
1. Apply the operators of quantum computing for different problems	PO1, PO3, PO6
2.Suggest quantum operators for any mathematical problem	PO1, PO3, PO4
3.Use and modify quantum search algorithms for real-time problems	PO2 , PO3, PO6
4.Suggest and modify quantum error correction algorithms for any applications	PO21, PO2 , PO3, PO6
5.Apply quantum computing for various security applications	PO3, PO7

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1.	10/08/2022 to 12/08/2022 4 hours	**UNIT 1 INTRODUCTION TO QUANTUM COMPUTATION** Global perspectives - Quantum bits - Quantum computation - Quantum algorithms - Classical computations on a quantum computer	PPT/CHALK AND TALK
2.	15/08/2022 to 19/08/2022 3 hours	- Quantum parallelism - Deutsch's algorithm - Deutsch–Jozsa algorithm - Quantum algorithms summarized - Experimental quantum information processing -	PPT/CHALK AND TALK
3.	15/08/2022 to 19/08/2022 1 hour	Quantum Gates problem solving 1	**Tutorial 1**
4.	22/08/2022 to 26/08/2022 3 hours	Quantum information - Postulates of quantum mechanics - Application: superdense coding - Density operator - Schmidt decomposition and purifications - EPR and the Bell inequality	PPT/CHALK AND TALK
5.	22/08/2022 to 26/08/2022 1 hour	Quantum Gates Problem Solving 2	**Tutorial 2**
6.	29/08/2022 to 02/09/2022 2 hours	**UNIT II QUANTUM COMPUTING** OPERATIONS Quantum circuits - Single qubit operations - Controlled operations - Measurement - Universal quantum gates - Simulation of quantum systems -	PPT/CHALK AND TALK
7.	05/09/2022 to 9/09/2022 3 hours	Quantum Fourier transform and its applications - Phase estimation - Applications: order-finding and factoring - General applications of the quantum Fourier - Quantum search algorithms - Quantum search as a quantum simulation -	PPT/CHALK AND TALK

8.	05/09/2022 to 9/09/2022 1 hour	Design of Quantum Circuit - 1	**Tutorial 3**
9.	12/09/2022 to 16/09/2022 3 hours	Quantum counting - Speeding up the solution of NP-complete problems - Quantum search of an unstructured database - Optimality of the search algorithm - Black box algorithm limits	PPT/CHALK AND TALK
10.	12/09/2022 to 16/09/2022 1 hour	Design of Quantum Circuit - 2	**Tutorial 4**
11.	19/09/2022 to 23/09/2022 1 hour	**Cycle Test I**	**Written**
12.	26/09/2022 to 30/09/2022 3 hours	**UNIT III QUANTUM INFORMATION** Quantum computers: physical realization - Guiding principles - Conditions for quantum computation- Harmonic oscillator quantum computer - Optical photon quantum computer - Optical cavity quantum electrodynamics - Ion traps	PPT/CHALK AND TALK
13.	26/09/2022 to 30/09/2022 1 hour	Quantum operations problem 1	**Tutorial 5**
14.	03/10/2022 to 07/10/2022 2 hour	Nuclear magnetic resonance - Other implementation schemes - Quantum information - Quantum noise and quantum operations - Classical noise and Markov processes -	PPT/CHALK AND TALK
15.	10/10/2022 to 14/10/2022 3 hours	Quantum operations Examples of quantum noise and quantum operations - Applications of quantum operations - Limitations of the quantum operations formalism	PPT/CHALK AND TALK
16.	10/10/2022 to 14/10/2022 1hour	Quantum operations problem 2	**Tutorial 6**
17.	17/10/2022 to 21/10/2022 3 hours	UNIT IV - QUANTUM ERROR CORRECTION Distance measures for quantum information - Distance measures for classical information- closeness of two quantum states – wellness of quantum channel information preservation- Quantum error-correction- Three qubit bit flip code - Three qubit phase	PPT/CHALK AND TALK

		flip code - Shor code	
18.	17/10/2022 to 21/10/2022 1 hour	Quantum error-correction problems solving 1	**Tutorial 7**
19.	24/10/2022 to 28/10/2022 3 hours	Theory of quantum error-correction- Constructing quantum codes - Classical linear codes – Calderbank–Shor–Steane codes- Stabilizer codes - Stabilizer formalism - Unitary gates and the stabilizer formalism - Measurement in the stabilizer formalism - Gottesman–Knill theorem - Stabilizer code constructions	PPT/CHALK AND TALK
20.	24/10/2022 to 28/10/2022 1 hour	Quantum error-correction problems solving 2	**Tutorial 8**
21.	31/10/2022 to 04/11/2022 2 hours	Fault-tolerant quantum computation- Fault-tolerance: the big picture- Fault-tolerant quantum logic- Fault-tolerant measurement- Elements of resilient quantum computation	PPT/CHALK AND TALK
22.	31/10/2022 to 04/11/2022 2 hour	UNIT V - QUANTUM INFORMATION THEORY Entropy and information - Shannon entropy- Basic properties of entropy - Von Neumann entropy- Strong subadditivity -	PPT/CHALK AND TALK
23.	07/11/2022 to 11/11/2022 2 hours	Quantum information theory- Distinguishing quantum states and the accessible information – Data compression -	PPT/CHALK AND TALK
24.	07/11/2022 to 11/11/2022 1 hour	Project	**Tutorial 9**
25.	14/11/2022 to 18/11/2022 3 hour	Classical information over noisy quantum channels - Quantum information over noisy quantum channels - Entanglement as a physical resource -	PPT/CHALK AND TALK

26.	14/11/2022 to 18/11/2022 1 hour	**Project**	**Tutorial 10**
27.	21/11/2022 to 25/11/2022 1 hour	**Cycle Test - II**	**Written**
28.	10/08/2022 to 12/08/2022 1 hour	Quantum cryptography	PPT/CHALK AND TALK
29.	10/08/2022 to 12/08/2022 1 hour	**Project**	**Tutorial 11**

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Cycle Test 1	19/09/2022 to 23/09/2022	1 hour	15
2	Cycle Test 2	21/11/2022 to 25/11/2022	1 hour	15
3	Tutorial & Assignments	Full Semester	Weekly assignment	10
4	Project	October, November, 2022	10 hours	20
	CPA Compensation Assessment*	As per academic schedule	1 hour	15
5	Final Assessment *	As per academic schedule	As per institute norms	40

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc

Textbooks

1. Nielsen, M., & Chuang, I. (2010). In Quantum Computation and Quantum Information: 10th Anniversary Edition, Cambridge: Cambridge University Press.
2. John Gribbin (2014), Computing with Quantum Cats: From Colossus to Qubits, Prometheus Books.
3. B.N. Murdin (2013) Quantum Computing from the Ground Up, by Riley Tipton Perry, Contemporary Physics

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

Feedbacks are collected before final examination through MIS or any other standard format followed by the institute.

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

MODE OF CORRESPONDENCE (email/ phone etc)

Email : 406118053@nitt.edu

COMPENSATION ASSESSMENT

One Retest will be conducted for absentees in Cycle Tests, for genuine reasons

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 75% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, or copying from others during an assessment will be treated as a punishable offence.
- Zero marks are to be awarded to the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson, HoD and other members, shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

The above policy against academic dishonesty shall be applicable to all the programmes.

ADDITIONAL INFORMATION, IF ANY

The Course Coordinator is available for consultation during official timings

Course Faculty 10/08/2022 (SELVAM.D) **CC-Chairperson** 22/8/22 **HOD** 22/8/2022