Module no. 1 title Core (New)	ALGORITHMS FOR QUANTUM COMPUTING
Module code and mode of delivery	EEP55C30
Module ECTS Weighting	10 ECTS
Semester of delivery	1 and 2
Module Contact Hours	33 (Lectures), 33 (Lab and Tutorials)
Module Coordinator	Prof Biswajit Basu
Module teaching staff and academic titles	Prof Biswajit Basu
Module description—content	Quantum control algorithms is an emerging area in response to the development of quantum computers which have been made feasible due to the recent breakthrough in hardware technologies. This would revolutionize applications related to simulation, optimization, security, medical application and drug design to name a few. The module considers theoretical development and application - oriented problem solving in the areas of: estimation, stochastic simulation, optimization, control and machine learning. The course will emphasize the interplay between theory and application with practical coding.
Module learning aims/objectives	1. To enable the students develop algorithms for quantum computers. 2. To develop capabilities to apply the quantum algorithms for solving problems in science and engineering. 3. To develop skills for identifying and develop quantum algorithms which have superior performance than traditional ones.
Module learning outcomes	On successful completion of the module students should be able to: **MLO1.1** Perform calculations with quantum algebra using Dirac notation. **MLO1.2** Apply period finding algorithms for solving related problems. **MLO1.3** Develop algorithm for Quantum Fourier Transform and apply it. **MLO1.4** Develop algorithm for Quantum Wavelet Transform and apply it. **MLO1.5** Solve problems and perform stochastic simulations using Quantum random walk. **MLO1.6** Solve optimization problems using quantum computing algorithms. **MLO1.7** Solve problems in Quantum Machine Learning.

Module assessment, separate components and their weighting to be mapped into SITS	The module contains a mixture of tutorials and conventional lab sessions where students will be able to seek assistance on their assignments. There will be 33 lecture hours which will be run over the two semesters. The guideline for a 10 ECTS module is for 250 hours of student effort including class hours. ASSESSMENT MODE(S) Assessment will be based on 60% Continuous Assessment and 40% final exam. Continuous Assessment will be a mixture of algorithm design assignments and in-class tests. The students on the course will be guided through adapting assignments to complement their chosen project if possible. SYLLABUS Introduction to Quantun mechanics and Quantum computers Linear Algebra and Dirac notation, Quantum gates and circuits Algorithms with super-polynomial speed-up Period finding algorithms Shor's algorithm, Factorization algorithm, Grover's algorithm Quantum Fourier Transform and applications Quantum Wavelet Transform and applications Quantum random walk and applications Quantum search algorithms and applications Introduction to Quantum Machine Learning Introduction to Quantum Cryptography Reading List: 1. An introduction to quantum computing (2010) by Kaye, Laflamme and Mosca. OUP 2. Quantum computation and quantum information (2010) by Nielsen and Cheung, CUP.