SECOND SEMESTER 2015-2016

COURSE HANDOUT (PART II)

Date: 9th January 2016

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

Course Number: BITS F386

Course Title: Introduction to Quantum Information and Computation

Instructor-in-Charge: Jayendra N. Bandyopadhyay

Scope & Objectives: This is an introductory course on a rapidly developing interdisciplinary field. Students from different disciplines will get opportunity to exchange ideas, which help them to develop base for advanced studies in many other interdisciplinary fields.

Course Description: This course is divided into three parts. (1) *Foundation:* Basic ideas and interpretation of quantum mechanics relevant for understanding quantum information. (2) *Quantum Computation:* Quantum circuit model, quantum gates, and quantum algorithms. (3) *Quantum Information:* Quantum version of Shannon's classical theory of information, quantum cryptography, error correction, etc.

Books:

(I) Textbook: Quantum Computation and Quantum Information, M. A. Nielsen and I. L. Chuang, Cambridge Univ. Press 2002 (**TB**)

(II) Reference books:

(a) Principles of Quantum Computation and Information, Vols. 1 & 2, G. Benenti, G. Casati, and G. Strini, World Scientific, 2007

(b) Quantum Theory: Concepts and Methods, A. Peres, Kluwer Academic Publishers, 1999

Course Plan:

Lec. #	Learning Objectives	Topics to be covered	Chap./Sec.
1	Introduction & Overview	------	----
2-13	Foundations	Postulates of quantum mechanics, qubits, Bloch sphere, composite systems (density	TB Chap. 1-2

		matrix, partial trace), entanglement (Schmidt decomposition), quantum eraser (GHJW theorem), EPR pairs, Bell and CHSH inequalities, No cloning theorem	
14-24	Quantum computation	Quantum circuit model and quantum gates, controlled gates, universal set of gates, superdense coding, teleportation, quantum algorithms (Deutsch, Deustsch-Jozsa, Shor,Grover)	TB Chap. 4-6
25-40	Quantum information	Shannon's coding theorem, Schumacher's quantum version, mathematical properties of von Neumann and relative entropy, Holevo bound, quantum error correction, quantum cryptography	TB Chap. 10-12

Evaluation Scheme:

No.	Evaluation Component	Duration	Weightage	Date & Time
1	Tutorials/Assignments/Seminars	--------	30%	
2	Mid-Term (Close book)	90 Mins	30%	16/3 9:00 - 10:30 AM
3	Comprehensive Exam. (Open*+Close book)	3 Hrs	40%	10/5 FN

***Open Book**: Only the books listed in the handout and handwritten notes are allowed.

Chamber Consultation Hours: To be announced in the class.

Notices: Will be uploaded on Intrabits site only.

Make-up Policy: Make-up will be given only in genuine cases, that is, illness leading to hospitalization or going out of station with prior permission. No make-ups for the tutorials.

Instructor-in-charge