Course Profile - Department of Physics

Course Number : PHYS 484	**Course Title : Special Topics (Quantum Computation and Quantum Information)**
Required / Elective : Elective	**Pre / Co-requisites :** -
Catalog Description: Special topics in physics.	**Textbook / Required Material :** Stig Stenholm, Kalle-Antti Suominen *Quantum Approach to Informatics*, Wiley, 2005.

Course Structure / Schedule : (3+0+0) 3 / 5 ECTS

Extended Description :

Introduction to quantum computing, qubit, qubit representation. Structure of quantum theory, quantum ensembles. Nonlocality of quantum mechanics, measurement. Irreversibility, classical communication. Quantum communication, fidelity. Quantum computing, classical and quantum logic operations, Deutsch problem. Classical universal computer, quantum computer. Quantum computing circuits and gates. Quantum algorithms, quantum teleportation, public key code. Errors in quantum computing. Requirements for quantum computers. Physical realization of quantum information processing.

Design content : None	**Computer usage**: None

Course Learning Outcomes [relevant program outcomes in brackets]**:**

On successful completion of this course students will be able to

1. define quantum bits (qubits), quantum registers and quantum gates [6];
2. demonstrate a knowledge of how quantum gates can be utilized to realize quantum algorithms by combining gates into circuits [6,7],
3. develop an insight into quantum teleportation protocol [6,7];
4. give examples of pioneering efforts to physically realize quantum computing circuits [5];
5. show an increased competence to effectively communicate an accomplished project in both written and verbal form [9].

Recommended reading:

1. M. A. Nielsen and I. L. Chuang, *Quantum Computation and Quantum Information*, Cambridge, 2000.
2. David J. Griffiths, *Introduction to Quantum Mechanics, 2nd ed.* Prentice-Hall, 2005.
3. Feynman, R.P., Leighton, R.B., Sands, M. *The Feynman Lectures on Physics, Volume III*, Addison Wesley, 1966.

Teaching methods:

Lectures of approximately 3 hours per week, pre-readings, homework problems, and a term paper.

Assessment methods:

Weekly homework assignments, quizzes, and a term paper.

Student workload:

Pre-reading	7 hrs
Lectures, discussions	45 hrs
Exercise sessions	0 hrs
Homework	25 hrs
Independent work	45 hrs
Laboratory work	0 hrs
Examinations	3 hrs
TOTAL …… 125 hrs … to match 25 x 5 ECTS	

Prepared by : İsmail Karakurt , 01.02.2010	**Revision Date :**