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Semester V (B.Tech.)

Er. No. 20183308

Academic Year: 2022-23

Jaypee University of Engineering & Technology, Guna

T-3 (Odd Semester 2022)

18B14PH541 INTRODUCTION TO QUANTUM COMPUTING

Maximum Duration: 2 Hours

Maximum Marks: 35

Notes:

1. This question paper has **05 (five)** questions.
2. Write relevant answers only.Do not write anything on the question paper (Except your Er. No.).
3. Symbols have their standard textbook meanings.

			Marks	CO
Q1.		Discuss Bloch sphere representation of single qubit superosed states. Further determine Bloch coordinates for the following states: (i) $\|\psi\rangle = \frac{1}{\sqrt{2}}(\|0\rangle + \|1\rangle)$ (ii) $\|\eta\rangle = \frac{1}{\sqrt{2}}(\|0\rangle - \|1\rangle)$ (iii) $\|\xi\rangle = \frac{1}{\sqrt{2}}(\|0\rangle + i\|1\rangle)$ (iv)$\|\Omega\rangle = \frac{1}{\sqrt{2}}(\|0\rangle - i\|1\rangle)$	7	CO2
Q2.		Define Concurrence for a two qubit state and discuss quantification of entanglement in terms of Concurrence.	7	CO5
Q3.	**(a)**	Consider an arbitrary function $f(x)$: $\{0,1\} \rightarrow \{0,1\}$ being implemented by a 2-qubit gate U_f such that U_f: $\|x\rangle\|y\rangle \rightarrow \|x\rangle\|y \oplus f(x)\rangle$. Show that: $\|\Psi\rangle = \|x\rangle\frac{1}{\sqrt{2}}(\|0\rangle - \|1\rangle)$ is an eigenstate of U_f operator with eigen value $(-1)^{f(x)}$. Further calculate the output by taking $\|x\rangle = \alpha_0\|0\rangle + \alpha_1\|1\rangle$.	4	CO3
	(b)	Write down key points of Deutsch algorithm and its advantages over the classical algorithm.	3	CO2
Q4.		Consider a function $f(x)$: $\{0,1\}^2 \rightarrow \{0,1\}$ such that $f(x) = 1$. Explicitly show that Deutsch-Jozsa algorithm works in this case by generating the vector $\|y\rangle = \|00\rangle$ as the final output. Illustrate your steps by drawing a suitable circuit diagram.	7	CO3
Q5.		Discuss Grover's search algorithm and prove that it solves the problem in approximately $\sqrt{2^n}$ trials.	7	CO3