BRAC UNIVERSITY
Department of Computer Science Engineering
Quiz 1
CSE 481: Quantum Computing 1
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Total Marks: 20   **Time: 30 minutes**

Name:	ID:	Section: 1

Question

Consider the following quantum states:

$$|\psi_a\rangle = \frac{2}{3}|0\rangle + \frac{1-2i}{3}|1\rangle$$

$$|\psi_b\rangle = \frac{4+4i\sqrt{3}}{3}|0\rangle + \frac{8-4i}{3}|1\rangle$$

(i)   Examine the quantum states $|\psi_a\rangle$ & $|\psi_b\rangle$ to determine whether they are normalized. If not, provide the necessary steps to normalize them and write down their normalized forms. **[2]**

(ii) $|\psi_a\rangle$ is measured in the basis:

$$|+\rangle = \frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle, \qquad |-\rangle = \frac{1}{\sqrt{2}}|0\rangle - \frac{1}{\sqrt{2}}|1\rangle$$

Find the probability of getting a $|1\rangle$. **[8]**

(iii)   If the subsequent measurement is performed using the same basis as in question (ii), what is the probability of obtaining outcome $|1\rangle$ again? **[1]**

(iv)   Determine the inner product $\langle 0|\psi_a\rangle$. Additionally, state the probability of getting a $|0\rangle$ when we measure $|\psi_a\rangle$. **[3]**

(v)   Express the relationship between the inner product and the probability found in question (iv) in one sentence. **[1]**

(vi)   Compute the inner product $\langle\psi_b|\psi_a\rangle$. Provide a brief explanation of what the result signifies. **[5+1bonus]**