1 Simplify $(\langle 0| \otimes I)(\alpha 00|00\rangle + \alpha 01|01\rangle + \alpha 10|10\rangle + \alpha 11|11\rangle)$

$$(\langle 0| \otimes I)(\alpha 00|00\rangle + \alpha 01|01\rangle + \alpha 10|10\rangle + \alpha 11|11\rangle)$$

$$\langle 0| \otimes I = \begin{bmatrix}1\\0\end{bmatrix} \otimes \begin{bmatrix}1 & 0\\0 & 1\end{bmatrix} = \begin{bmatrix}1 & 0\\0 & 1\\0 & 0\\0 & 0\end{bmatrix}$$

$$\implies (\langle 0| \otimes I)(\alpha 00|00\rangle + \alpha 01|01\rangle + \alpha 10|10\rangle + \alpha 11|11\rangle) = \begin{bmatrix}1 & 0\\0 & 1\\0 & 0\\0 & 0\end{bmatrix} (\alpha 00|00\rangle + \alpha 01|01\rangle + \alpha 10|10\rangle + \alpha 11|11\rangle)$$

$$= \begin{bmatrix}\alpha 00|00\rangle + \alpha 01|01\rangle + \alpha 10|10\rangle + \alpha 11|11\rangle\\0\\0\\0\end{bmatrix}$$

$$= \alpha 00|00\rangle + \alpha 01|01\rangle + \alpha 10|10\rangle + \alpha 11|11\rangle$$

(1)