2.26

$U|S_z;+\rangle = |S_x;+\rangle \Rightarrow \langle S_z;+|U|S_z;+\rangle = \langle S_z;+|S_x;+\rangle$

$U|S_z;-\rangle = |S_x;-\rangle \quad \langle S_z;-|U|S_z;+\rangle = \langle S_z;-|S_x;+\rangle$

$\langle S_z;+|U|S_z;-\rangle = \langle S_z;-|S_x;-\rangle$

$\langle S_z;-|U|S_z;-\rangle = S_z;-|S_x;-\rangle$

$|S_x;\pm\rangle = \frac{1}{\sqrt{2}}|S_z;+\rangle \pm \frac{1}{\sqrt{2}}|S_z;-\rangle$

$\langle S_z;+|S_x;\pm\rangle = \frac{1}{\sqrt{2}}$, $\langle S_z;-|S_x;\pm\rangle = \pm\frac{1}{\sqrt{2}}$

$$U \doteq \frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

$U = |S_x;+\rangle\langle S_z;+| + |S_x;-\rangle\langle S_z;-|$

$= \frac{1}{\sqrt{2}}\left(|+\rangle\langle+| + |-\rangle\langle+| + |+\rangle\langle-| - |-\rangle\langle-|\right)$

Then

$\langle+|U|+\rangle = \frac{1}{\sqrt{2}}$, $\langle+|U|-\rangle = \frac{1}{\sqrt{2}}$, $\langle-|U|+\rangle = \frac{1}{\sqrt{2}}$, $\langle-|U|-\rangle = -\frac{1}{\sqrt{2}}$

so

$$U \doteq \frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$