A Givens rotations on modes j and k performs the transformation

$$\begin{pmatrix} c_j^\dagger \\ c_k^\dagger \end{pmatrix} \mapsto \begin{pmatrix} \cos\theta & -e^{i\varphi}\sin\theta \\ \sin\theta & e^{i\varphi}\cos\theta \end{pmatrix} \begin{pmatrix} c_j^\dagger \\ c_k^\dagger \end{pmatrix} = \begin{pmatrix} \cos\theta c_j^\dagger - e^{i\varphi}\sin\theta c_k^\dagger \\ \sin\theta c_j^\dagger + e^{i\varphi}\cos\theta c_k^\dagger \end{pmatrix}. \tag{1}$$

In the two-qubit subspace corresponding to modes j and k, with $j < k$, under the JWT, we have

$$|00\rangle = |\text{vac}\rangle \tag{2}$$
$$|01\rangle = c_k^\dagger|\text{vac}\rangle \tag{3}$$
$$|10\rangle = c_j^\dagger|\text{vac}\rangle \tag{4}$$
$$|11\rangle = c_j^\dagger c_k^\dagger|\text{vac}\rangle. \tag{5}$$

Plugging in Eq. (1), we get that the Givens rotation performs the transformation

$$|00\rangle \mapsto |00\rangle \tag{6}$$
$$|01\rangle \mapsto e^{i\varphi}\cos\theta|01\rangle + \sin\theta|10\rangle \tag{7}$$
$$|10\rangle \mapsto -e^{i\varphi}\sin\theta|01\rangle + \cos\theta|10\rangle \tag{8}$$
$$|11\rangle \mapsto e^{i\varphi}|11\rangle. \tag{9}$$

So the corresponding two-qubit gate is

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{i\varphi}\cos\theta & -e^{i\varphi}\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & e^{i\varphi} \end{pmatrix}. \tag{10}$$