Let $H_0 = -E_c\frac{\partial^2}{\partial\phi^2} - E_J\cos\phi$, $H_0\psi$ become :

$$\text{even} : -\frac{E_c}{\sqrt{\pi}}\left(\sum_{m=1}^{\infty}(-m^2)a_m\cos m\phi - \frac{a_0}{\sqrt{2}}\gamma\cos\phi - \frac{\gamma}{2}\sum_{m=1}^{\infty}a_m(\cos(m+1)\phi + \cos(m-1)\phi)\right) \tag{1}$$

$$\text{odd} : -\frac{E_c}{\sqrt{\pi}}\left(\sum_{m=1}^{\infty}(-m^2)b_m\sin m\phi - \frac{\gamma}{2}\sum_{m=1}^{\infty}a_m(\sin(m+1)\phi + \sin(m-1)\phi)\right) \tag{2}$$

And its matrix form is :

$$E_c\begin{pmatrix} 0 & -\frac{\gamma}{2} & 0 & 0 & \cdots \\ -\frac{\gamma}{\sqrt{2}}\cos\phi & \cos\phi & -\frac{\gamma}{2}\cos\phi & 0 & \cdots \\ 0 & -\frac{\gamma}{2}\cos 2\phi & 4\cos 2\phi & -\frac{\gamma}{2}\cos 2\phi & \cdots \\ 0 & 0 & -\frac{\gamma}{2}\cos 3\phi & 9\cos 3\phi & \cdots \\ \vdots & \vdots & \vdots & \vdots & \cdots \end{pmatrix}\begin{pmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \\ \vdots \end{pmatrix} \tag{3}$$

$$E_c\begin{pmatrix} \sin\phi & -\frac{\gamma}{2}\sin\phi & 0 & 0 & \cdots \\ 0 & -\frac{\gamma}{\sqrt{2}}\sin 2\phi & 4\sin 2\phi & -\frac{\gamma}{2}\sin 2\phi & \cdots \\ 0 & 0 & -\frac{\gamma}{2}\cos 3\phi & 9\cos 2\phi & \cdots \\ 0 & 0 & 0 & -\frac{\gamma}{2}\cos 4\phi & \cdots \\ \vdots & \vdots & \vdots & \vdots & \cdots \end{pmatrix}\begin{pmatrix} b_1 \\ b_2 \\ b_3 \\ \vdots \end{pmatrix} \tag{4}$$

Also, let form of ψ as : $\psi(x) = \sum_{-\infty}^{\infty}\frac{c_m e^{im\phi}}{\sqrt{2\pi}}$, $H_0\psi$ is :

$$\frac{E_c}{\sqrt{2\pi}}\left(\sum_{-\infty}^{\infty}c_m m^2 e^{im\phi} - \gamma\sum_{-\infty}^{\infty}c_m e^{i(m+1)\phi} - \gamma\sum_{-\infty}^{\infty}c_m e^{i(m-1)\phi}\right) \tag{5}$$

for $m \geq 0$,

$$\frac{E_c}{\sqrt{2\pi}}\begin{pmatrix} 0 & -\gamma & 0 & 0\cdots \\ -\gamma e^{i\phi} & e^{i\phi} & -\gamma e^{i\phi} & 0\cdots \\ 0 & -\gamma e^{i2\phi} & 4e^{i2\phi} & -\gamma e^{i2\phi}\cdots \\ 0 & 0 & -\gamma e^{i3\phi} & 9e^{i3\phi}\cdots \\ \vdots & \vdots & \vdots & \cdots \end{pmatrix}\begin{pmatrix} c_0 \\ c_1 \\ c_2 \\ c_3 \\ \vdots \end{pmatrix} \tag{6}$$