given we know the boundary condition $\phi(0,t)=0$, we can remove the first row (which keep in mind is an equation which states what ϕ_0 is) we have a new matrix

$$\frac{-U}{2\Delta x}\begin{pmatrix} -1 & 0 & 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 & 0 & 1 \\ 0 & 0 & 0 & 0 & -2 & 2 \end{pmatrix} + \frac{\nu}{\Delta x^2}\begin{pmatrix} 1 & -2 & 1 & 0 & 0 & 0 \\ 0 & 1 & -2 & 1 & 0 & 0 \\ 0 & 0 & 1 & -2 & 1 & 0 \\ 0 & 0 & 0 & 1 & -2 & 1 \\ 0 & 0 & 0 & 1 & -2 & 1 \end{pmatrix}$$

But this is a downgrade in a sense, it's 5×6. Square matrices allow for certain evaluation tricks like inversion, diagonalization. fortunately, Since the first column multiplies ϕ_0 which we know, we can pull out that first column (being careful not to forget the pre-factors)

from $(-1)\left(\frac{-U}{2\Delta x}\right)$

$$\frac{\partial}{\partial t}(\vec{\phi}) = \underbrace{\left[\frac{-U}{2\Delta x}\begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ -1 & 0 & 1 & 0 & 0 \\ 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & -1 & 0 & 1 \\ 0 & 0 & 0 & -2 & 2 \end{pmatrix} + \frac{\nu}{\Delta x^2}\begin{pmatrix} -2 & 1 & 0 & 0 & 0 \\ 1 & -2 & 1 & 0 & 0 \\ 0 & 1 & -2 & 1 & 0 \\ 0 & 0 & 1 & -2 & 1 \\ 0 & 0 & 1 & -2 & 1 \end{pmatrix}\right]}_{L'}\begin{pmatrix} \phi_1 \\ \phi_2 \\ \phi_3 \\ \phi_4 \\ \phi_5 \end{pmatrix} + \underbrace{\begin{pmatrix} \frac{U}{2\Delta x} + \frac{\nu}{\Delta x^2} \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}}_{P}\phi_0$$