$$F_N = \frac{1}{\sqrt{N}} \begin{bmatrix} 1 & 1 & 1 & \dots & 1 \\ 1 & \omega & \omega^2 & \dots & \omega^{N-1} \\ 1 & \omega^2 & \omega^4 & \dots & \omega^{2(N-1)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & (\omega^{N-1}) & (\omega^{2(N-1)} & \dots & \omega^{(N-1)(N-1)} \end{bmatrix}, \omega = e^{-2\pi i/N}$$