1.Consider a projection matrix, $\mathbf{P}$. What are the eigenvalues of $\mathbf{P}$?

Since P is a projection matrix, $P=P^2$

$\lambda x = Px = P^2x = \lambda Px = \lambda^2 x$

$\lambda = \lambda^2$

Therefore, $\lambda = 0 \text{ or } 1$

2.What are the eigenvalues of the Householder transformation

$H=H^T=H^{-1}$

$H^2x = \lambda Hx = \lambda^2 x$

Also, $H^2x = H^{-1}Hx = x$

Therefore, $\lambda^2 x = x$, $\lambda = 1 \text{ or } -1$