4. a) $J(w) = C(w) + \lambda R(w)$

$$\frac{\partial J(w)}{\partial w} = \frac{1}{N}\sum_{n=1}^{N}\left[\frac{\partial C^n(w)}{\partial w}\right] + \lambda \frac{\partial \|w\|^2}{\partial w}$$

$$= \frac{1}{N}\sum_{n=1}^{N}\sum_{j=1}^{I}\sum_{k=1}^{K}\left[\frac{\partial C^n(w)}{\partial w_{kj}}\right] + 2\lambda w$$

$$= \frac{1}{N}\sum_{n=1}^{N}\sum_{j=1}^{I}\sum_{k=1}^{K}\left[-x_j^n(y_k^n - \hat{y}_k^n)\right] + 2\lambda w$$

$$= \frac{1}{N}\sum_{n=1}^{N}\left[-x^n(y^n - \hat{y}^n)\right] + 2\lambda w$$

$$= \underline{-\frac{1}{N}\sum_{n=1}^{N}\left[x^n(y^n - \hat{y}^n)\right] + 2\lambda w}$$