(4a) $\bar{A}\bar{x}_t + \bar{B}\bar{u}_t = \bar{x}_{t+1}$

$$\begin{pmatrix} A & c \\ 0 & 1 \end{pmatrix}\begin{pmatrix} x_t \\ 1 \end{pmatrix} + \begin{pmatrix} B \\ 0 \end{pmatrix} u_t = \begin{pmatrix} x_{t+1} \\ 1 \end{pmatrix}$$

$Ax_t + c + Bu_t = x_t$ $\quad$ c shifts the origin, causing function to be affine

$1 = 1$

(4b) $\bar{x}_T^T \bar{Q}_f \bar{x}_T + \sum_{t=1}^{T-1} x_t^T Q\bar{x}_t + \bar{u}_t^T R\bar{u}_t$

$$J(u_{1:T-1}) = \begin{bmatrix} x_t & 1 \end{bmatrix}\begin{bmatrix} Q_f & q_f \\ q_f^T & h \end{bmatrix}\begin{bmatrix} x_t \\ 1 \end{bmatrix} + \sum_{t=1}^{T-1} \begin{bmatrix} x_t & 1 \end{bmatrix}\begin{bmatrix} Q & q \\ q^T & h \end{bmatrix}\begin{pmatrix} x_t \\ 1 \end{pmatrix} + u_t R u_t$$

(4c) An affine system that could be controlled w/ this method could be an inverted pendulum system. The effect of gravity in mechanical systems would be best solved through an affine system since the origin would not be fixed.