

3F2

1. (a)  $C(sI - A)^{-1}B_2 + D$   
(b)  $x(t) = e^{At}x(0) + \int_0^t e^{A\tau}B_2d(t - \tau) d\tau$
2. (a)  $0 \leq k \leq \frac{\lambda^2}{2m}, \frac{2m\alpha}{\lambda}$ .  
(b)  $p \geq \frac{20\lambda}{m}$
3. (d)  $l_1 = 4 - 1/T_1 = 3, l_4 = T/\omega^2 = 14.59$
4. (a)  $f_e = 1/8, u_e = \tanh^{-1}(1/8) = 0.1257$   
(b)  $A = \begin{bmatrix} -3/4 & 1 \\ 0 & -2 \end{bmatrix}, B = \begin{bmatrix} 0 \\ \frac{126}{64} \end{bmatrix}$  (for  $x_1 = v, x_2 = f$ )  
(c)  $k_1 = -0.2857, k_2 = -0.2286$