3F2 Systems and Control: 2006 Numerical answers

1. (a) —
   (b) —
   (c)

$$A = -\frac{1}{10}, \qquad B = \left[1, -\tfrac{1}{2}\right]$$
$$C = \begin{bmatrix} \frac{1}{10} \\ 1 \end{bmatrix}, \qquad D = \begin{bmatrix} 0 & \frac{1}{2} \\ 0 & 0 \end{bmatrix}$$

   (d) —

2. (a) Gain: 16. Third pole: -6.
   (b) Exact value is 51.
   (c) —
   (d) —

3. (a) —
   (b) —
   (c) If $x = [\theta, \dot{\theta}, z, \dot{z}]^T$ then

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ \gamma & 0 & 0 & 0 \end{bmatrix}, \qquad B = \begin{bmatrix} 0 \\ \alpha \\ 0 \\ 0 \end{bmatrix}$$

   (d) —
   (e) —

4. (a) —
   (b) If $x = [\dot{\theta}, \theta, v]^T$ then

$$A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & -1 \end{bmatrix}, \qquad B = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$$

   (c) —
   (d)

$$L = \begin{bmatrix} 2 \\ 2 \\ 1 \end{bmatrix}$$

   (e) —