MS4328 Problem Sheet 4

All questions deal with continuous-time LTI systems.

1. Check that the system described by

$$A = \begin{pmatrix} -23 & 40 \\ -15 & 26 \end{pmatrix}, \qquad b = \begin{pmatrix} 3 \\ 2 \end{pmatrix}, \qquad c = \begin{pmatrix} 1 & -2 \end{pmatrix}$$

   is CC. Then use the pole placement algorithm to design a linear state feedback controller which stabilises the system.

2. Check that the system described by

$$A = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{pmatrix}, \qquad b = \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}$$

   is CC. Then use the pole placement algorithm to design a linear state feedback controller which places all three poles of the closed loop system to the left of those of the open loop system.
   Hint: The characteristic polynomial of A is $\lambda^3+6\lambda^2+11\lambda+6 = (\lambda+1)(\lambda+2)(\lambda+3)$.

3. Check that the system described by

$$A = \begin{pmatrix} -5 & 4 \\ -1 & 0 \end{pmatrix}, \qquad c = \begin{pmatrix} 1 & 0 \end{pmatrix}$$

   is CO. Design a full order state estimator (or *Luenberger* observer) which has its pole 3 times further into LHP than the system itself.

4. For the system of Q1, design a full order state estimator which will be used to implement the feedback control law determined in Q1.