Homework 4, due April 11th 5pm CST

Handin at 1102 DCL. Slide under door if TA not present.

Important: Please type or *neatly* write your solutions. Anything we can't read will receive no credit. You must show appropriate work to receive full credit.

1. (20 points) Suppose we have a PD control system with K_p equal to 3.2, K_d equal to 2.4, and the mass of the object we're trying control equal to 0.4.

   (a) What are the eigenvalues for this system? Is it stable? (5 points)

   (b) Assuming the object is initially at rest, what is the 95% settle time of the system? (The time after which the position errors will be less than 5% of the initial position error). Show your work. (Recall that if s_1 and s_2 are distinct eigenvalues, then the error is $x(t) = c_1 e^{s_1 t} + c_2 e^{s_2 t}$ where c_1 and c_2 are constants.) (15 points)

2. Serial I/O (20 points)

   (a) Show the encoding of the signal `11100010` as a waveform using (i) Manchester Encoding and (ii) NRZI. For NRZI, assume the line is at `0` before transmission starts. For Manchester Encoding, use the method discussed in the class lecture notes. (15 points)

   (b) What are some advantages and disadvantages of using Manchester Encoding? NRZI? (5 points)

3. Schedulability Utilization Bound Test (60 points)

   For the following items, calculate if the tasks listed are schedulable based on the Schedulability Utilization Bound Test and, if necessary, the Exact Schedulability Test.

   (a) τ_1 has execution time $C_1 = 2$ and $T_1 = 7$.
   τ_2 has execution time $C_2 = 6$ and $T_2 = 11$.
   τ_3 has execution time $C_3 = 4$ and $T_3 = 35$.

   (b) τ_1 has execution time $C_1 = 2$ and $T_1 = 9$.
   τ_2 has execution time $C_2 = 6$ and $T_2 = 21$.
   τ_3 has execution time $C_3 = 4$ and $T_3 = 25$.
   τ_4 has execution time $C_4 = 3$ and $T_4 = 35$.

   (c) τ_1 has execution time $C_1 = 2$ and $T_1 = 9$.
   τ_2 has execution time $C_2 = 6$ and $T_2 = 21$.
   τ_3 has execution time $C_3 = 4$ and $T_3 = 25$.
   τ_4 has execution time $C_4 = 4$ and $T_4 = 35$.

   (d) τ_1 has execution time $C_1 = 6$ and $T_1 = 10$.
   τ_2 has execution time $C_2 = 3$ and $T_2 = 20$.
   τ_3 has execution time $C_3 = 8$ and $T_3 = 40$.