Problem 1 Use two different methods to find the unit-step response of

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = [2 \;\; 3]\mathbf{x}$$

Problem 2 Discretize the state equation in **Problem 1** for $T = 1$ and $T = \pi$.

Problem 3 Given the scalar system: $x' = ax + br$ **where x(0) = 10**

Let a = -2 b = 5 and r(t) is the unit step, u(t)

Part I

- Using the state transition equation compute the closed solution for x(t) with the given IC and input u(t). Use the Convolution integral form (not Laplace)
- Validate your solution using the Laplace transform from of the State transition equation and invert.

Part II

Let T = 1/8 sec

a) Find Ad
b) Find Bd (using both formulas given in notes/text)
c) Write the discrete time state equations x[k+1] = f(x[k], u[k])
d) Look at the Matlab function "c2d" use the "zoh" option – do you get same results? See also CT_DT_Example_Week7 file in WK6 handouts
e) Using Matlab or Excel or something else recursively compute x[1] thru x[10] note that u[k] = 1 for all k.