

# Assignment-2

Instructor: Dr. Shaurya Agarwal  
EE-5600, Spring 2018

February 23, 2018

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Instructions:

- Please complete all the questions and prepare a pdf copy.
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**Question 1:** A robot-arm drive system for one joint can be represented by the differential equation

$$\frac{dv(t)}{dt} = -k_1v(t) - k_2y(t) + k_3i(t)$$

where  $v(t)$  = velocity,  $y(t)$  = position, and  $i(t)$  is the control-motor current (Hint:  $i(t) = u(t)$ ). Put the equations in state variable form and set up the matrix form for  $k_1 = k_2 = 1$ .

**Question 2:** The state space representation of a dynamical system is given as

$$X'(t) = AX(t) + BU(t)$$

$$Y(t) = CX(t) + DU(t)$$

Prove that:

$$Y(t) = C \left[ \Phi(t)X(0) + \int_0^t \Phi(t-\tau).B.U(\tau)d\tau \right] + DU(t)$$

where  $\Phi(t) = e^{At}$  is the fundamental or state transition matrix.

Following problems are from the text book:

**Question 3:** 2.1

**Question 4:** 2.3

**Question 5:** 2.6

**Question 6:** 2.14

**Question 7:** 2.15

**Question 8:** 2.20