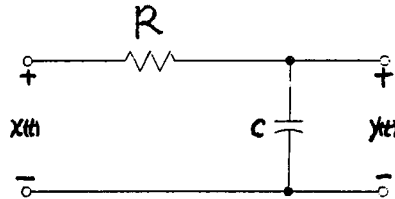


編號：F 329 系所：醫學工程研究所乙組

科目：控制工程

1. (25%) The RC circuit is shown as following figure. The  $x(t)$  and  $y(t)$  are the system input and output, respectively. Please answer the following questions!



- (a) Derive the transfer function of the system. (3 points)  
 (b) If the input is unit step function,  $y(0)=0$ , please find and plot the system response. (5 points)  
 (c) Please find the time constant of the system. (3 points)  
 (d) For a signal processing, this circuit is a low-pass filter or high-pass filter? Why? (5 points)  
 (e) Find the cutoff frequency. (4 points)  
 (f) If the resistor and capacitor are interchanged, that circuit will be a low-pass or high-pass filter? Why? (5 points)
2. (25%) The system can be described as a differential equation  $a\ddot{y}(t) + b\dot{y}(t) + cy(t) = u(t)$ . The  $u(t)$  and  $y(t)$  are the system input and output, respectively. Please answer the following questions.
- (a) Find the transfer function of the system. Explain how to get the system impulse response? (5 points)  
 (b) Utilize the state variable to derive the dynamic equations of the system. (5 points)
- $$\dot{x} = Ax + Bu$$
- $$y(t) = Cx$$
- (c) Utilize matrices  $A, B, C$  on (b) to derive the transfer function of the system. (5 points)  
 (d) Take examples for mechanical system and RLC circuit to obtain similar second order differential equation. You have to point out how to derive those differential equations. (10 points)

3. (15%) The system is described by  $\dot{x}(t) = Ax(t) + Bu(t)$

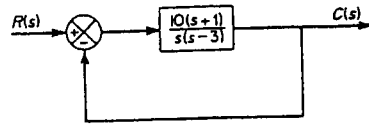
$$\text{Where } A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Using the state feedback method, place the poles of the system at -4 and -6.

4. (20 %) Explain the following questions: (5 points each)
- (a) What is definition of the time-invariant system?  
 (b) Why the state feedback will not change the controllability, may change the observability?  
 (c) Why we often use integrator, but not differentiator in control system?  
 (d) What is the definition of causal system?

(背面仍有題目,請繼續作答)

5.(15%) The following figure shows the system with an unstable forward transfer function.



- Sketch the root locus plot ( 5points)
- Locate the closed loop poles. (5 points)
- Show that the unit step response curve will exhibit overshoot. (5 points)