CBCS Scheme

USN | | | | | | | | | | 15EC43

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Control Systems

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define control system. Distinguish between open loop and closed loop systems with examples. **(05 Marks)**

b. Write the differential equations for the mechanical system shown in Fig.Q1(b) and obtain F-V and F-I analogous electrical networks. **(05 Marks)**

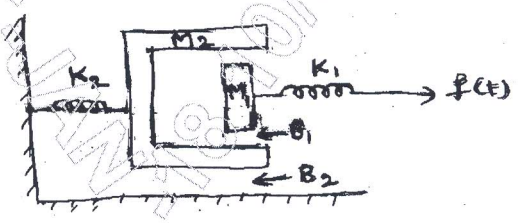

Fig.Q1(b)

c. Using Mason's gain formula, find the gain of the system shown in Fig.Q1(c). **(06 Marks)**

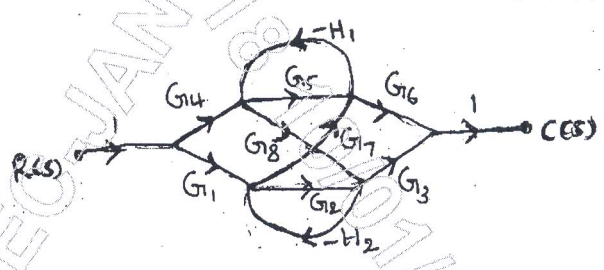

Fig.Q1(c)

OR

2 a. Write the Mason's gain formula for signal flow graph. Indicate what each term represents. **(04 Marks)**

b. Show that two systems shown in Fig.Q2(a) are analogous systems, by comparing their functions. **(06 Marks)**

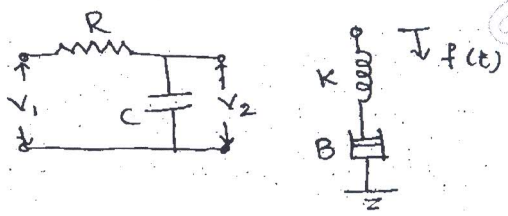

Fig.Q2(b)

c. Reduce the block diagram shown in Fig.Q2(c) using reduction rules and obtain C(s)/R(s). **(06 Marks)**

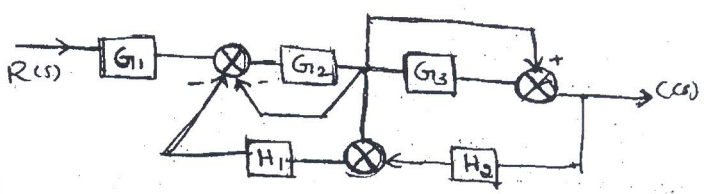

Fig.Q2(c)

Module-2

3 a. Obtain an expression for time response of the first order system subjected to unit step input. **(04 Marks)**

b. Explain proportional + integral + differential controller and their effect on stability. **(06 Marks)**

c. A unity feedback system is characterized by an open loop transfer function $G(s) = \frac{k}{s(s+10)}$.

Determine the gain K so that system will have a damping ratio of 0.5. For this value of K, find settling time (2% criterion), peak overshoot and time to peak overshoot for a unit step input. **(06 Marks)**

OR

4 a. With a neat sketch explain all the time domain specifications. **(10 Marks)**

b. For the system shown in Fig.Q4(b). Determine the value of 'a' which gives damping factor 0.7. What is the steady state error to unit ramp input for value of 'a'. **(06 Marks)**

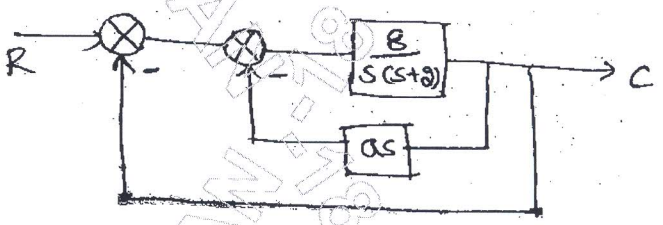

Fig.4Q(b)

Module-3

5 a. State and explain Routh-Hurwitz criterion. **(05 Marks)**

b. List the advantages of Root Locus method. **(05 Marks)**

c. Using RH criterion determine the stability of the system having the characteristic equation :
$s^6 + 2s^5 + 5s^4 + 8s^3 + 8s^2 + 8s + 4 = 0$. **(06 Marks)**

OR

6 a. By applying Routh criterion, discuss the stability of the closed loop system as a function of K for the following open loop transfer function :

$$G(s)H(s) = \frac{K(s+1)}{s(s-1)(s^2+4s+16)}.$$ **(06 Marks)**

b. The open loop transfer function of a control system is given by $G(s) = \frac{k}{s(s+2)(s^2+6s+2s)}$.

Sketch the complete root locus as k is varied from zero to infinity. **(10 Marks)**

Module-4

7 a. The open loop transfer function of a system is $G(s) = \frac{K}{s(1+0.5s)(1+0.2s)}$ using Bode plot.

Find K so that : i) Gain margin is 6dB ii) Phase margin is 25°. **(12 Marks)**

b. What is Nyquist plot? State the Nyquist stability criterion. **(04 Marks)**

OR

8 a. The open loop transfer function of a control system is $G(s)H(s) = \frac{1}{s^2(s+2)}$. Sketch the Nyquist plot, path and ascertain the stability. **(10 Marks)**

b. Write a note on lead compensator. **(06 Marks)**

Module-5

9 a. What is signal reconstruction? Explain it with sample and hold circuit. **(08 Marks)**

b. Consider the circuit of Fig.Q9(b). Identify suitable state variables and write its state vector matrix equation. Note that there are two inputs. **(08 Marks)**

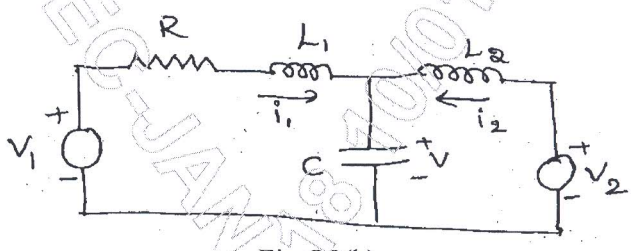

Fig.Q9(b)

OR

10 a. List the properties of state transition matrix. **(06 Marks)**

b. A single input single output system has the state and output equations :

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r$$

$$y = [5 \quad 0]\, x$$

i) Determine its transfer function

ii) Find its state transition matrix. **(08 Marks)**

c. What is sampled data control system? **(02 Marks)**

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