USN | | | | | | | | | | **10ES43**

Fourth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Control System

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Draw the F-V the F-I analogous circuits for the mechanical system shown in Fig.Q.1(a) with necessary equations. **(12 Marks)**

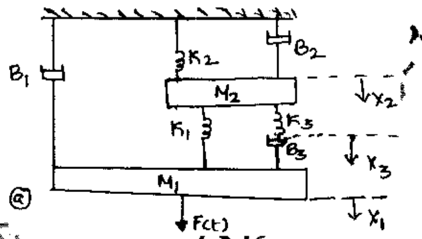


Fig.Q.1(a)

b. For the rotational mechanical system shown draw the torque-voltage analogous circuit for Fig.Q.1(b). **(08 Marks)**

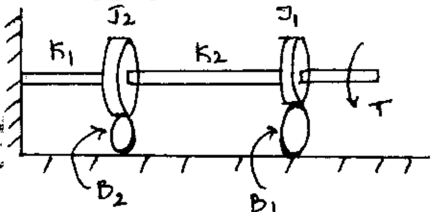


Fig.Q.1(b)

2 a. Using the block diagram reduction technique find $\frac{C}{R}$ for Fig.Q.2(a). **(05 Marks)**

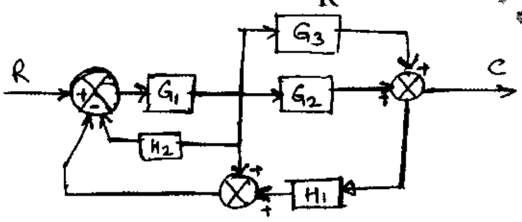


Fig.Q.2(a)

b. Draw the signal flow graph for the block diagram shown in Fig.Q.2(b) and find the TF. **(08 Marks)**

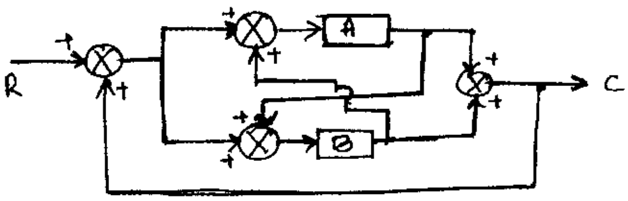


Fig.Q.2(b)

c. Draw the signal flow graph and find the TF Fig.Q.2(c). **(07 Marks)**

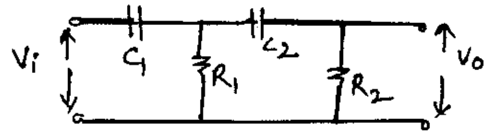


Fig.Q.2(c)

3 a. Find the error coefficients K_p, K_v and K_a for the system having

$$G(s) = \frac{10}{s^2 + 2s + 9} \; \& \; H(s) = 0.2.$$ **(06 Marks)**

b. Find K_1 so that $\xi = 0.35$. Find the corresponding time domain specifications for Fig.Q.3(b). **(06 Marks)**

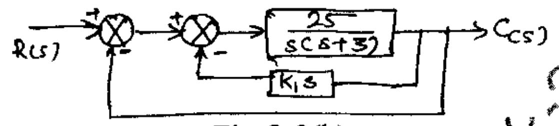


Fig.Q.3(b)

c. With respect to a second order system define the following by drawing neat response curve and expressions: i) Maximum overshoot (M_p); ii) Time delay (t_d); iii) Time constant (T); iv) Rise time (t_r). **(08 Marks)**

4 a. What are the necessary and sufficient conditions for a system to be stable according to Routh-Hurwitz criterion? **(04 Marks)**

b. What value of K makes the following unity feedback system stable?

$$G(s) = \frac{K(s+1)^2}{s^3}.$$ **(04 Marks)**

c. Find how many roots have real parts greater than -1 for the characteristic equation.
$s^3 + 7s^2 + 25s + 39 = 0$. **(04 Marks)**

d. How many roots of the characteristic polynomial lie in the right half of S-plane, the left half of s-plane and on jw axis. Comment on the stability of the system.
$P(s) = s^5 + 2s^4 + 2s^3 + 4s^2 + s + 2$. **(08 Marks)**

PART – B

5 a. What are the angle and magnitude conditions that a point on root locus has to satisfy? **(06 Marks)**

b. Sketch the root locus for the unity feedback control system whose open loop transfer function is $G(s) = \frac{1}{s(s+2)(s^2+4s+13)}$. **(14 Marks)**

6 a. With respect to Nyquist criterion explain the following:
   i) Encirclement of a point.
   ii) Analytic function and its singularities.
   iii) Mapping theorem or principle of argument.
   iv) Find the number of encirclements of point A in Fig.Q.6.1(a) and 6.1(b). **(08 Marks)**

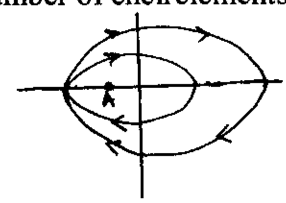


Fig.Q.6.1(a)

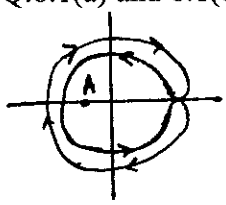
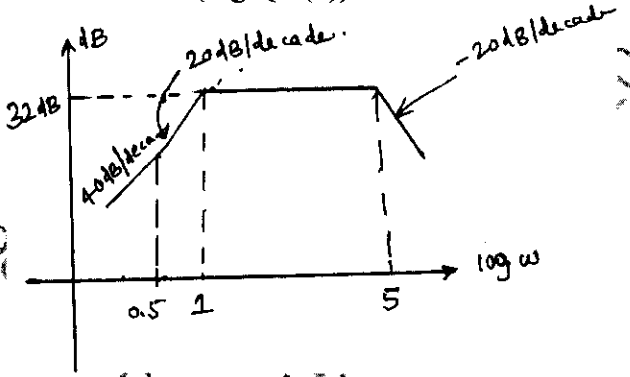


Fig.Q.6.1(b)

b. For the open loop TF of a feedback control system $G(s)H(s) = \frac{K(1+2s)}{s(1+s)(1+s+s^2)}$. Sketch the complete Nyquist plot and hence find the range of K for stability using Nyquist criterion. **(12 Marks)**

7 a. Draw the bode plot for a system having
$$G(s) = \frac{K(1+0.2s)(1+0.025s)}{s^3(1+0.01s)(1+0.005s)}.$$
Comment on the stability of the system. Also find the range of K for stability. **(12 Marks)**

b. For the plot shown determine the TF (Fig.Q.7(b)). **(08 Marks)**



(Fig.Q.7(b)

8 a. What are the advantages of state space analysis? **(04 Marks)**

b. A system is described by the differential equation
$$\frac{d^3y}{dt^3} + \frac{3d^2y}{dt^2} + \frac{17dy}{dt} + 5y = 10u(t)$$
Where y is the output and u is the input to the system. Determine the state space representation of the system. **(06 Marks)**

c. Obtain the state equations for the electrical network shown in Fig.Q.8(c). **(10 Marks)**

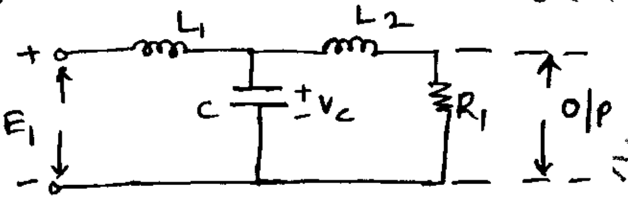


Fig.Q.8(c)

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