CBCS Scheme

USN | | | | | | | | | | **15MT34**

Third 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 a control system. List merits and demerits of open-loop and closed loop control system. **(05 Marks)**

b. Draw the mechanical network. Write the differential equations of performance and also draw F-V analogous electrical circuit of the system shown in Fig.Q1(b).

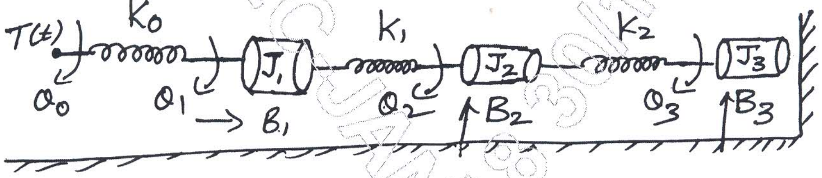

Fig.Q1(b) **(06 Marks)**

c. Illustrate how to perform the following in connection with block diagram reduction techniques:
i) Shifting a summing point ahead of a block and behind a block.
ii) Shifting a take off point after a summing point and before a summing point.
iii) Removing minor feedback loop. **(05 Marks)**

OR

2 a. List the requirements of a good control system. **(04 Marks)**

b. For the mechanical system shown in Fig.Q2(b). Draw the mechanical network. Write the differential equations of performance and also draw force-to-current analogous electric circuit.

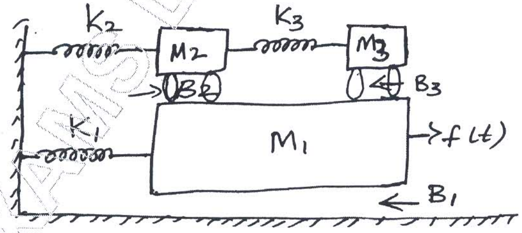

Fig.Q2(b) **(06 Marks)**

c. Find $\frac{C(s)}{R(s)}$ of the system shown in Fig.Q2(c) using block diagram reduction method.

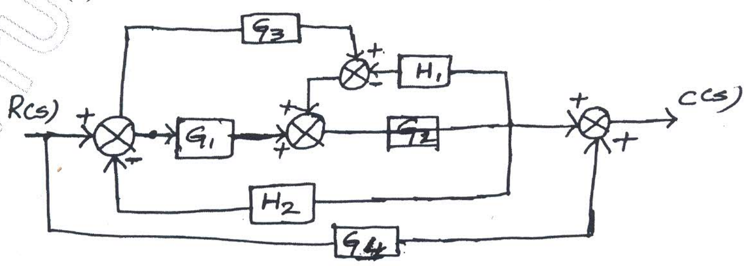

Fig.Q2(c) **(06 Marks)**

Module-2

3 a. The signal flow graph shown in Fig.Q3(a) determine the transfer function $\frac{C(s)}{R(s)}$ using Mason's formula.

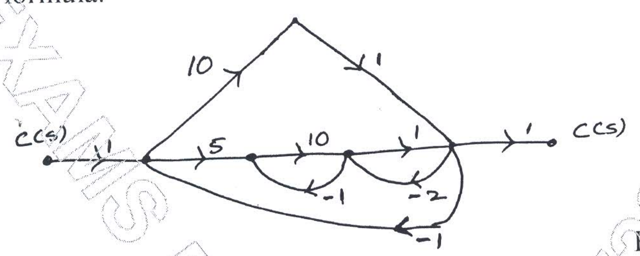

Fig.Q3(a) **(06 Marks)**

b. What are the standard test signals used in time domain analysis and give their Laplace transforms? **(04 Marks)**

c. For the shown in Fig.Q3(c), find the followings:
   i) System type
   ii) Static error constants, K_p, K_v and K_a.
   iii) Steady state error for an input r(t) = 5u(t).

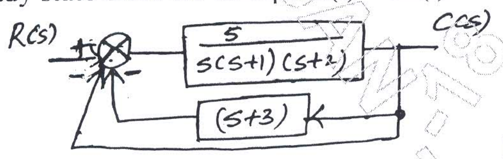

Fig.Q3(c) **(06 Marks)**

OR

4 a. For the signal flow graph shown in Fig.Q4(a), determine the transfer function using Mason's gain formula.

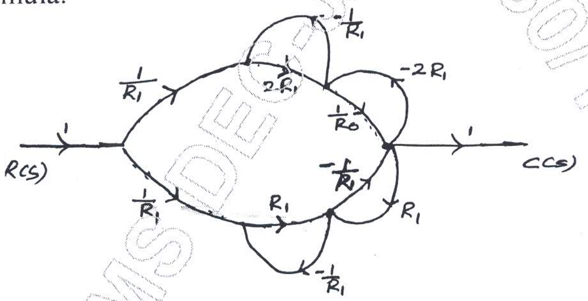

Fig.Q4(a) **(08 Marks)**

b. Derive an equation for unit step response of a second order system for under-damped case. **(08 Marks)**

Module-3

5 a. Using Routh criteria determine the stability of the following :
   i) $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$
   ii) $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ **(08 Marks)**

b. Sketch the complete root locus of system having $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$. Comment on stability. **(08 Marks)**

OR

6 a. State and explain Routh Hurwitz criterion of stability. **(04 Marks)**

b. $S^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$. Find the number of roots of this equation with positive real part, zero real part and negative real part. **(04 Marks)**

c. The open loop transfer function of a control system is given by $G(s)=\dfrac{K}{s(s+2)(s^2+6s+25)}$. Sketch the complete root locus as K is varied from 0 to infinity. **(08 Marks)**

Module-4

7 a. List the advantages of frequency domain approach. **(04 Marks)**

b. Define the terms "gain margin" and "phase margin". Explain how these can be determined from Bode plot. **(04 Marks)**

c. Investigate the stability of a negative feedback control system whose open loop transfer function is given by $G(s)H(s)=\dfrac{100}{(s+1)(s+2)(s+3)}$ using Nyquist stability criterion. **(08 Marks)**

OR

8 a. For a particular unity feedback system $G(s)=\dfrac{242(s+5)}{s(s+1)(s^2+5s+121)}$. Sketch the Bode plot. Find W_{gc}, W_{pc}, GM and PM. **(08 Marks)**

b. Draw a polar plot for a negative feedback control system having an open loop transfer function $G(s)H(s)=\dfrac{100}{s^2+10s+100}$. **(04 Marks)**

c. Explain Nyquist stability criterion. **(04 Marks)**

Module-5

9 a. Define the following terms:
i) state ii) state variable iii) state vector **(04 Marks)**

b. Obtain the state model of the given electrical network shown in Fig.Q9(b).

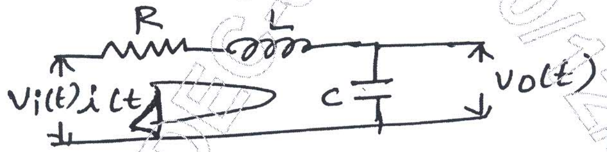

Fig.Q9(b) **(04 Marks)**

c. Obtain the solution of the homogeneous state equation $\dot{X}=AX$ where $A=\begin{bmatrix}1 & -2\\ 1 & -4\end{bmatrix}$ and $X[0]=\begin{bmatrix}0.5\\ 1\end{bmatrix}$. **(08 Marks)**

OR

10 a. Construct the state model using phase variables if the system is described by the differential equation.

$$\frac{d^3y(t)}{dt^3}+4\frac{d^2y(t)}{dt^2}+7\frac{dy(t)}{dt}+2y(t)=5u(t)$$

and draw the state diagram. **(06 Marks)**

b. List the properties of state transition matrix. **(04 Marks)**

c. Find the state transition matrix for $A=\begin{bmatrix}0 & -1\\ +2 & -3\end{bmatrix}$ using Laplace transform method. **(06 Marks)**

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