CBCS SCHEME

USN | | | | | | | | | | |

17AE71

Seventh Semester B.E. Degree Examination, July/August 2021
Control Engineering

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Explain open loop and closed loop control systems with an example. **(10 Marks)**

b. Explain the requirements of an ideal control system. **(10 Marks)**

2 a. Derive the transfer function of field controlled D.C. motor. **(10 Marks)**

b. Obtain the equation of equilibrium and draw analogous electrical network based in FV analogy for the mechanical system shown in Fig.Q2(b). **(10 Marks)**

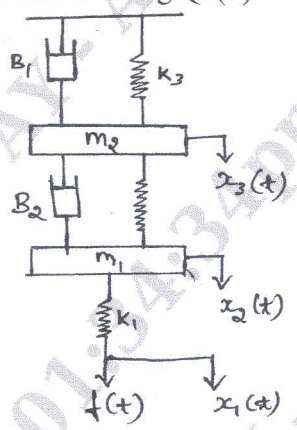

Fig.Q2(b)

3 a. Determine the transfer function C(s)/R(s) from the block diagram shown in Fig.Q3(a).

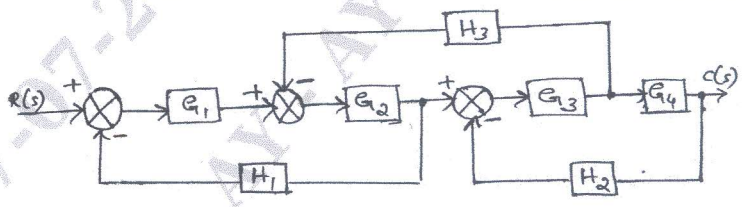

Fig.Q3(a) **(10 Marks)**

b. Find the transfer function for the system shown in Fig.Q3(b), using Mason's gain formula.

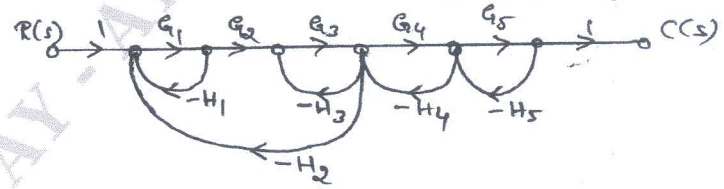

Fig.Q3(b) **(10 Marks)**

4 a. Obtain an expression for time response of the first order system subjected to unit step input. **(10 Marks)**

b. Unity feedback control system is characterized by an open loop transfer function

$$G(s)H(s) = \frac{k}{s(s+10)}$$

Determine the system gain k, so that the system will have a damping ratio of 0.5. For this value of k, find the rise time, peak time, settling time and peak over shoot for a unit step input. **(10 Marks)**

5 Draw the complete root locus diagram for the system with open loop transfer function

$$G(s).H(s) = \frac{k}{s(s+2)(s^2+8s+20)}$$

Determine the range of variation of k over which the system remains stable. **(20 Marks)**

6 Sketch the Bode plot for

$$G(s).H(s) = \frac{10}{s(1+s)(1+0.02s)}$$

Also obtain the gain margin and phase margin and cross over frequencies. **(20 Marks)**

7 a. Plot the polar diagram for the open loop transfer function

$$G(s).H(s) = \frac{10}{s(s+1)(s+2)}$$

(12 Marks)

b. Define the following terms :
(i) Gain margin (ii) Phase margin (iii) Gain crossover frequency
(iv) Phase crossover frequency **(08 Marks)**

8 Using Nyquist criteria, investigate the stability of a system whose open loop transfer function is $G(s).H(s) = \frac{4s+1}{s^2(1+s)(1+2s)}$ **(20 Marks)**

9 a. Briefly explain proportional – derivative and proportional – integral controller with block diagram and mathematical equations. **(12 Marks)**

b. Write notes on :
(i) Lag compensator (ii) Lead compensator **(08 Marks)**

10 a. Explain the following:
(i) Kalman's test of controllability (ii) Kalman's test of observability. **(10 Marks)**

b. Define the following terms:
(i) State variables (ii) State vector **(04 Marks)**

c. Determine whether the following system is observable or not.

$$\begin{Bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{Bmatrix} = \begin{bmatrix} -5 & 4 \\ -6 & 5 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} + \begin{Bmatrix} 1 \\ 1 \end{Bmatrix} u$$ and $y = \{-2 \quad 3\}x$ using Kalman's test. **(06 Marks)**

* * * * *