CBCS SCHEME

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

17MT34

Third Semester B.E. Degree Examination, Aug./Sept.2020
Control Systems

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define control system. With neat diagram, distinguish between open loop and closed loop and closed loop control systems, with suitable examples. **(10 Marks)**

b. For a mechanical system shown in Fig.1(b), write mechanical network, differential equations and obtain F – V analogous electrical network.

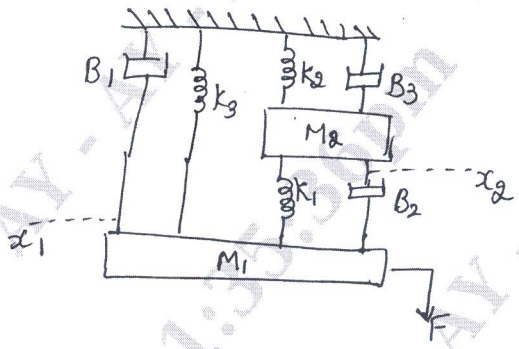

Fig.Q1(b) **(10 Marks)**

OR

2 a. Obtain $\frac{C(s)}{R(s)}$ using block diagram reduction rules.

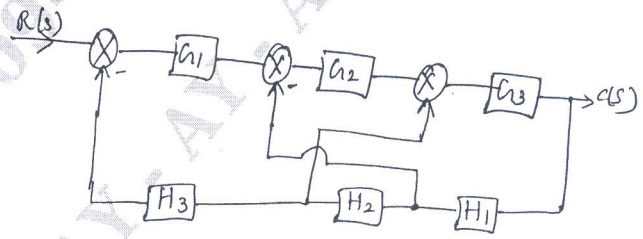

Fig.Q2(a) **(12 Marks)**

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

c. Illustrate how to perform the following in convection with block diagram reduction techniques.
   i) Shifting a summing point beyond the block
   ii) For blocks in parallel. **(04 Marks)**

Module-2

3 a. Determine T.F. using Mason gain formula. (Refer Fig.Q3(b)).

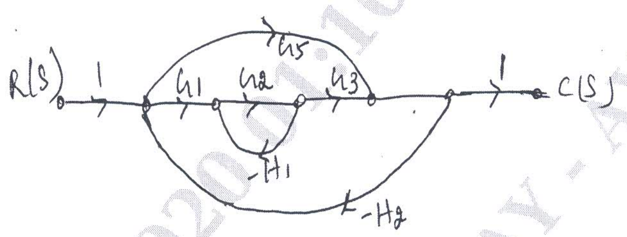

Fig.Q3(a) **(10 Marks)**

b. Explain the terms related to signal flow graph.
   i) Forward path
   ii) Self loop
   iii) Forward path gain
   iv) Non touching loops
   v) Source node. **(10 Marks)**

OR

4 a. Derive an equation for time response of a second order system subjected to a unit step input. **(10 Marks)**

b. A system is given by differential equation $\frac{d^2y}{dt^2}+\frac{4dy}{dt}+8y=8x$ where y = output and x = input. Determine all time domain specification for unit step input. **(10 Marks)**

Module-3

5 a. Comment on stability using Routh's criteria, if the characteristic equation is $s^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$. Find the number of roots of this equation with positive real part, zero real part and negative real part. **(12 Marks)**

b. Write the necessary and sufficient conditions for a system to be in stabile using Routh's criterion. **(04 Marks)**

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

OR

6 a. Sketch the root locus plot for $G(s)H(s)=\frac{K}{s(s+2)(s+4)}$. **(10 Marks)**

b. What is root loci? Explain the following terms :
   i) Centriod ii) Asymeptotes iii) Breakaway point. **(10 Marks)**

Module-4

7 a. What are the advantages and limitations of frequency domain approach? **(06 Marks)**

b. Define the terms with respect to bode plots.
   i) Gain margin ii) Phase margin iii) Phase crossover frequency. **(04 Marks)**

c. A unity feedback control system has $G(s)=\frac{80}{s(s+2)(s+20)}$. Draw the bode plot. Determine G.M, P.M. Wg_c and Wp_c. Convert on stability. **(10 Marks)**

OR

8 a. Draw polar plot of $G(s)H(s) = \dfrac{100}{(s+2)(s+4)(s+8)}$. **(10 Marks)**

b. Determine the number of encirclements about the origin in Fig.Q8(b) below.

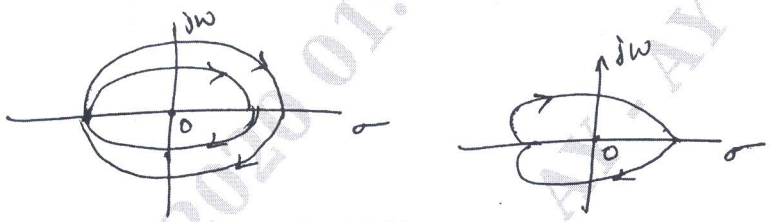

Fig.Q8(b) **(04 Marks)**

c. Explain the steps to solve by Nyquist criterion. **(06 Marks)**

Module-5

9 a. Obtain the state model of the given electrical system. Take $e_1(t)$, $e_2(t)$ as input variables and voltage across R as output variable.

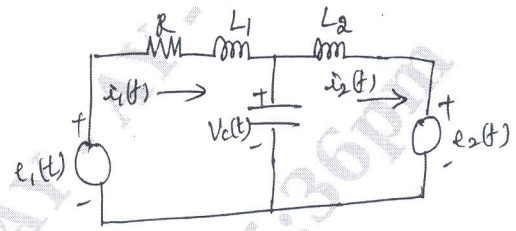

Fig.Q9(a) **(08 Marks)**

b. Derive the equation for transfer function form state model. **(08 Marks)**

c. Write the advantages of phase variables. **(04 Marks)**

OR

10 a. Obtain the state transition matrix for the following system :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Also obtain inverse of the state transition matrix $\phi^{-1}(t)$. **(12 Marks)**

b. The state model of the system is given by :

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -4 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t), \quad \begin{bmatrix} X_1(0) \\ X_2(0) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \text{ where } \begin{matrix} u(t) = 0 & \text{for } t < 0 \\ = e^{-t} & \text{for } t \geq 0 \end{matrix}$$

Obtain the response of the system. **(08 Marks)**

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