CBCS SCHEME

USN | | | | | | | | | |

18MT34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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 the following terms: with respect to control system.
i) Control ii) System iii) Input iv) Output v) Plant vi) Process
vii) Disturbance viii) Feedback path vix) open loop x) closed loop. **(10 Marks)**

b. Find the transfer function $\frac{X_2(s)}{F(s)}$ for the control system shown below. **(10 Marks)**

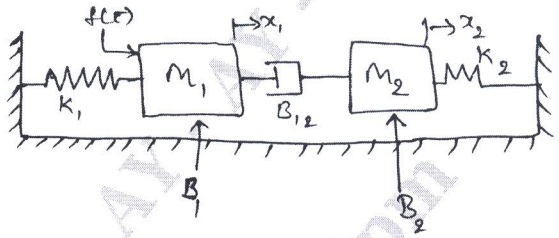

Fig.Q.1(b)

OR

2 a. Write the force equation and draw the analogous electrical network. **(12 Marks)**

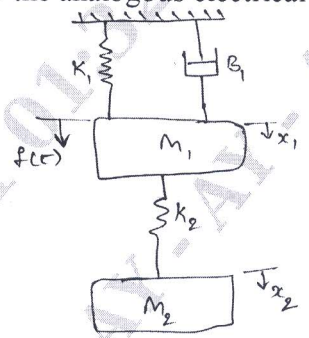

Fig.Q.2(a)

b. Obtain the C(S) in terms of inputs R(S) and Y(S). **(08 Marks)**

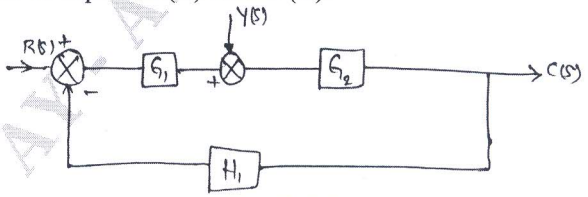

Fig.Q.2(b)

Module-2

3 a. Construct the SFG for the set of system equations:
$Y_2 = G_1Y_1 + G_3Y_3$; $Y_3 = G_4Y_1 + G_2Y_2 + G_5Y_3$; $Y_4 = G_6Y_2 + G_7Y_3$; where Y_4 is output.
Find T.F $\frac{Y_4}{Y_1}$. **(10 Marks)**

b. Find transfer function by Maron's gain formula for the SFG shown below. **(10 Marks)**

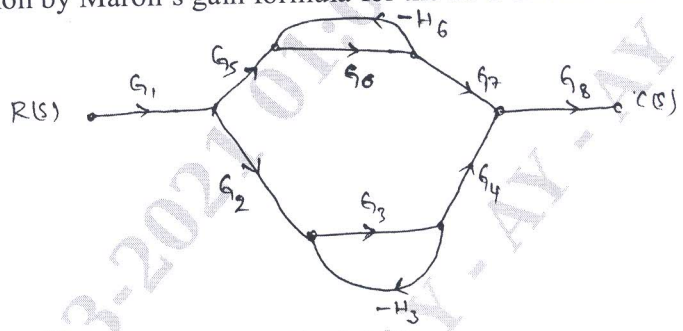

Fig.Q.3(b)

OR

4 a. Find K_p, K_v, K_a and steady state error for a system with open loop transfer function as
$G(S).H(S) = \frac{10(S+2)(S+3)}{S(S+1)(S+5)(S+4)}$; where the input is $r(t) = 3 + t + t^2$. **(10 Marks)**

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

Module-3

5 a. Define the following terms with respect to stability:
i) Absolute stable
ii) Conditionally stable
iii) Critically stable
iv) Relative stability. **(08 Marks)**

b. For unity feedback system, $G(S) = \frac{K}{S(1+0.4S)(1+0.25S)}$. Find the range of values of K, marginal value of K and frequency of oscillations (W). **(08 Marks)**

c. Write location of roots for a stable system and unstable system in an s-plane. **(04 Marks)**

OR

6 a. Define Bandwidth. Derive an expression of the same for a standard second order system. **(10 Marks)**

b. Define the following with respect to the frequency domain analysis:
i) Resonant peak and resonant frequency
ii) Cut off frequency
iii) Gain cross over frequency
iv) Phase cross frequency
v) Cut off rate. **(10 Marks)**

Module-4

7 Draw the approximate root locus diagram for the closed loop system whose transfer function is given by $G(S).H(S) = \frac{k}{S(S+5)(S+10)}$. Comment on stability. **(20 Marks)**

OR

8 a. Write 3 general graphs of Bode plots showing different conditions of stable system; unstable system and marginally stable system. **(09 Marks)**

b. A unity feed back system has $G(S) = \frac{80}{S(S+2)(S+20)}$. Draw Bode plot and comment on stability. **(11 Marks)**

Module-5

9 a. Define state, state variables, state space and state trajectory. **(04 Marks)**

b. Derive an expression for transfer function from the state model. **(08 Marks)**

c. A second order system is obtained by $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 2y(t) = U(t)$. Obtain the state transition matrix. **(08 Marks)**

OR

10 a. Find state transition matrix for state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$ **(08 Marks)**

b. Consider a system having state model

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} u \; ; \; y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

with D = 0. Obtain transfer function. **(08 Marks)**

c. List any 4 properties of state transition matrix. **(04 Marks)**

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