Question Paper

Exam Date & Time: 14-Oct-2020 (09:30 AM - 01:00 PM)

BMS COLLEGE OF ENGINEERING

Autonomous Institute Affiliated to VTU, Supplementary Semester End Main Examinations, October 2020

Control Systems [19ES4ESCST]

Marks: 100 **Duration: 210 mins.**

Electrical Clusters, Sem:IV

Answer all the questions.

Instructions:
1. Answer FIVE full questions using the given internal choice
2. Missing data, if any, may be suitably assumed

1) a) Differentiate between open- loop and closed-loop control systems (5)

b) For the mechanical system shown in figure 1. (b), find the transfer function $\frac{\theta(s)}{T(s)}$ (10)

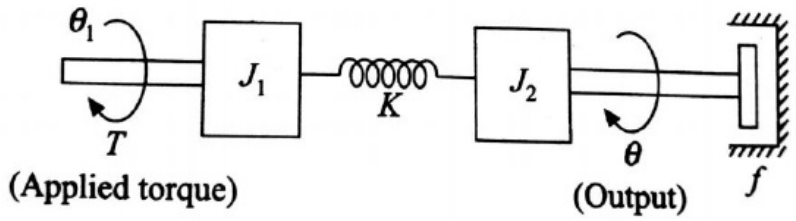

figure 1. (b)

c) Find the transfer function of a system whose block diagram as shown in the figure (c) below: (5)

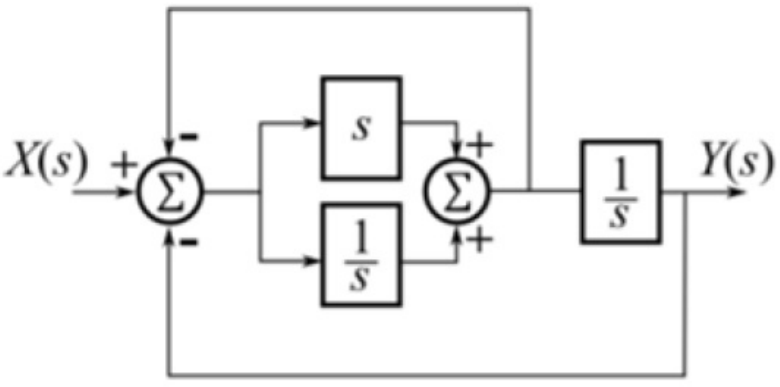

figure 1. (c)

[OR] 2) a) What are analogous systems? Explain Force - Current analogy. (5)

a)

b) For the system as shown in figure 2 (b), find the transfer function using block diagram reduction approach and verify the same by using signal flow graph method. (10)

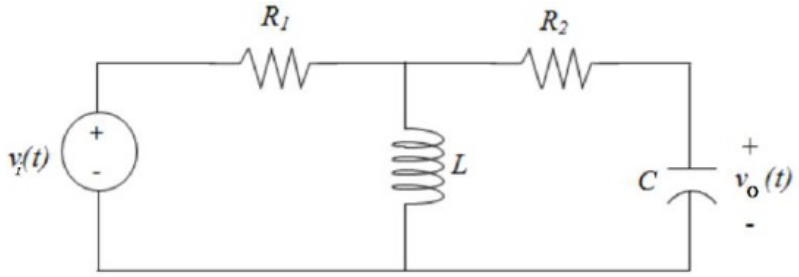

figure 2 (b)

c) Consider a linear time invariant system whose input r(t) and output y(t) are related by the following differential equation: $\frac{d^2y(t)}{dt^2} + 4\,y(t) = 6\,r(t)$. Find the poles of the system (5)

3) (10)

a)

The open loop transfer function of a unity feedback system is $\frac{4}{s(s+1)}$. Determine

(i) The response of a closed-loop system for a unit step input

(ii) Rise time, Peak time, Peak overshoot and Settling time

b) Consider the system as shown in figure 3(b) below: (10)

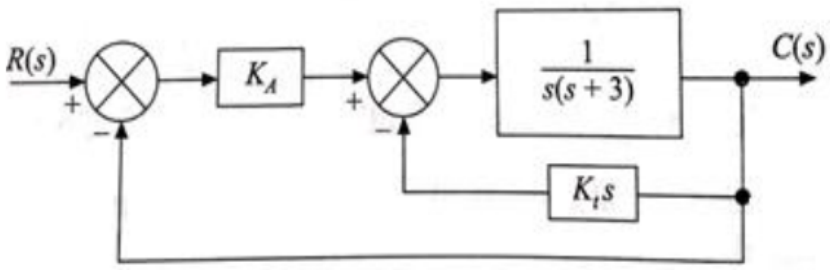

figure 3(b)

(i) In the absence of derivative feedback, determine the damping factor and natural frequency for $K_A = 15$.

(ii) Determine the derivative feedback constant which will increase the damping factor of system to 0.7

4) (14)

a) The open loop transfer function of a unity negative feedback system is given by k

$G(s) = \frac{}{s(s+2)(s^2+6s+25)}$. Draw the root locus for all positive values of K

b) For the feedback system shown figure 4 (b), find the values of 'a' and 'k' so that the system oscillates at a frequency of 2 rad/sec (6)

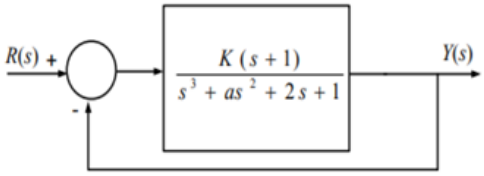

figure 4 (b)

5) (12)

a) The open loop transfer function of a negative unity feedback system is given by $\frac{k(s+3)(s+5)}{(s-2)(s-4)}$. Find the range of K for closed-loop stability using Nyquist criteria

b) (8)

Find the transfer function for the given Bode plot shown in figure 5 (b).

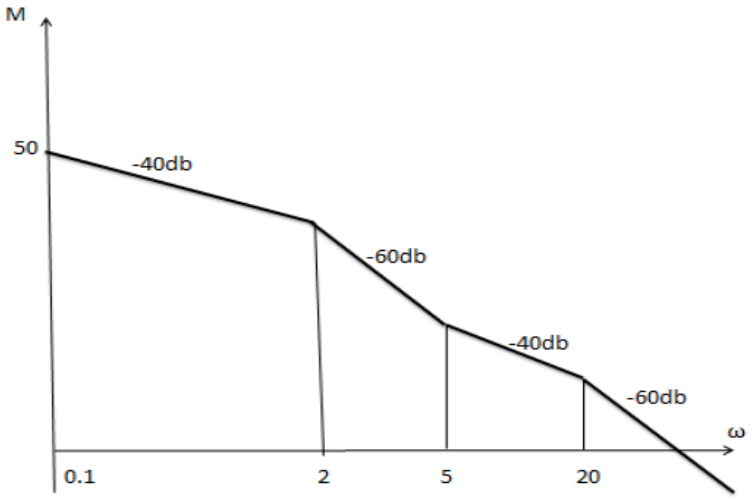

figure 5 (b)

[OR] (8)

6)

a)

A negative feedback system is characterized by an open loop transfer function, $GH(s) = \frac{6}{(s^2+2s+2)(s+2)}$. Find the following

(i) Gain cross over frequency

(ii) Phase cross over frequency

(iii) Gain margin

(iv) Phase margin

b) The open-loop transfer function of a negative feedback control system is given by, (12)

$G(s)\,H(s) = \frac{2000}{s(s+2)(s+100)}$. Find gain margin, phase margin and hence Comment on stability using BODE plot

7) (10)

a) A state variable description of a system is given by the matrix equation,

$$\dot{X} = \begin{bmatrix} -1 & 0 \\ 1 & -2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$Y = [1 \quad 1]\, X$$

Determine (i) The Transfer function

(ii) The State transition matrix

b) (10)

Represent the electrical circuit shown in figure 7 (b) by a state model

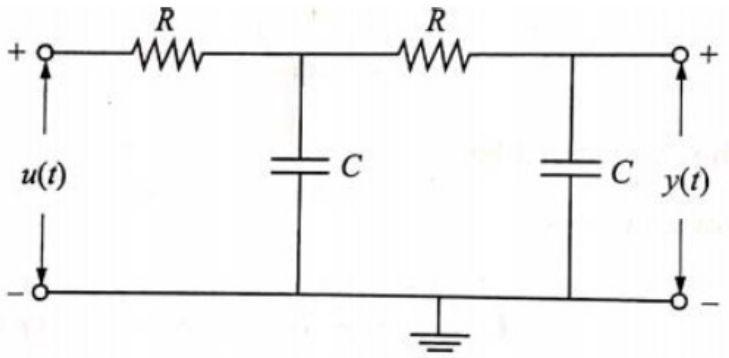

figure 7 (b)

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