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B. Tech 6th Semester Examination

Control Engineering

EE-6005

Time : 3 Hours   **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all selecting one question from each of the sections A, B, C, & D. Section E is compulsory. Use of non-programmable calculators is allowed. Use semi-log paper and graph paper, if required.

SECTION - A

1. (a) Compare open loop control with closed loop control. Give suitable examples.

    (b) Describe the major rules of block diagram reduction technique of deriving transfer function. Compute the overall transfer function of the system shown in figure 1, where u is system input and y is system output.
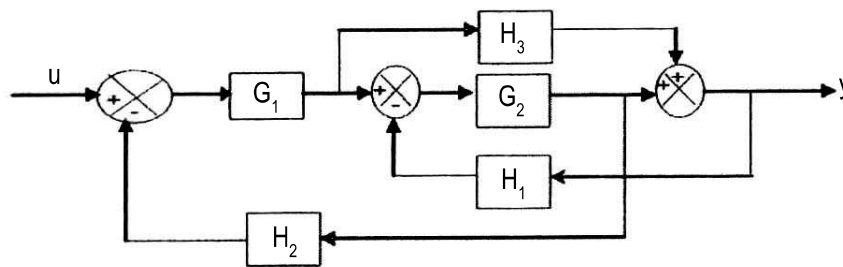

Figure 1   (6+14=20)

2. (a) Draw the analogous electrical network of the system given in figure 2 using Force-Voltage analogy.
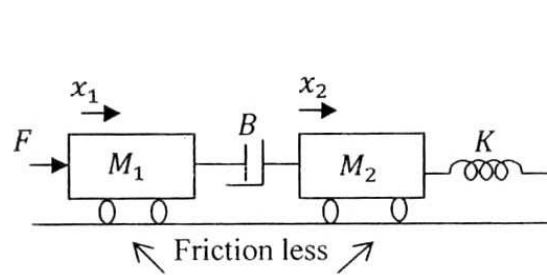

Figure 2

(b) What do you understand by positive and negative feedback systems? Give their advantages and disadvantages. (12+8=20)

SECTION - B

3. (a) Derive the values of static error coefficients and steady state error for a type-I system with unit step input.

(b) For a unity feedback control system having closed loop transfer function $\dfrac{C(s)}{R(s)} = \dfrac{Ks+b}{(s^2+as+b)}$, determine the open loop transfer function. Also show that steady state error in the unit ramp input response is given by $e_{ss} = \dfrac{a-K}{b}$.

(6+14=20)

4. (a) A feedback system is described by transfer function $G(s) = \dfrac{12}{(s^2+4s+16)}$ with H(s) = Ks. The damping factor of the system is 0.8. Determine the overshoot of the system and the value of parameter K.

(b) Check the stability of system represented by following characteristic equation:
$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$. (10+10=20)

SECTION - C

5. (a) Draw the magnitude and phase plot for a general second order control system using Bode technique.

    (b) The forward path transfer function of a unity feedback control system is given by

    $$G(s)H(s) = \frac{100}{s(s+6.54)}$$

    Find the resonant peak, resonant frequency and bandwidth of closed loop system. (8+12=20)

6. (a) How to establish stability of closed loop system using Nyquist criterion? Explain in detail.

    (b) Draw the Nyquist plot for unity feedback control system with open loop transfer function $G(s) = \frac{K(1-s)}{(s+1)}$. Also determine the stability of closed loop system.(6+14=20)

SECTION - D

7. (a) Explain the principle of operation of AC and DC techogenerators in detail.

    (b) What is compensation? Discuss various schemes of compensation used for control system design.

    (8+12=20)

8. (a) What are synchros? How does synchro pair act as error detector? Explain.

    (b) Design a suitable lag compensator network for a system with $G(s) = \frac{K}{s(2+s)(20+s)}$ to meet out following specifications: velocity constant $K_v = 20$ sec^{-1} and phase margin PM $\geq 35°$. (8+12=20)

    [P.T.O.]

SECTION - E

9. Give short answers:

   (a) What is transfer function of a LTI system? Explain

   (b) What are poles and zeros of a LTI system? Explain.

   (c) What is damping ratio? How does it affect the response of the system?

   (d) Define impulse response of a system. What is its significance?

   (e) What causes the appearance of entire row of zeros in Routh's table? Explain.

   (f) Find the steady state error for a unit step input in case of a unity feedback system with forward path transfer function given as $G(s) = \dfrac{100(s+2)\,(s+6)}{s(s+3)\,(s+4)}$.

   (g) What kind of compensation improves steady state error? Explain.

   (h) Define Gain Margin (GM) and Phase Margin (PM).

   (i) Find the unit step response of a system given by transfer function $G(s) = \dfrac{1}{s(s+2)}$.

   (j) What are the advantages of frequency response technique of analysis? Explain. (10×2=20)