Dr Ram Nivas Mahu

1/5/2023

Roll No.....

National Institute of Technology, Hamirpur (H.P.)

Examination: B.Tech. End Semester Examination, May-2023

Branch : Electrical Engineering | Semester : VI[th]

Course : Control Engineering | Code : EE-321

Time: 03:00 Hours | **Maximum Marks: 50**

Instruction: Attempt all the questions.

Q. 1. Draw the mechanical equivalent network (or nodal diagram) and write the nodal equations for the system shown in Figure 1 and also draw the electrical voltage analog. **[05]**

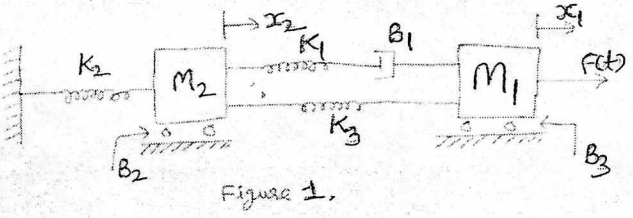

Figure 1.

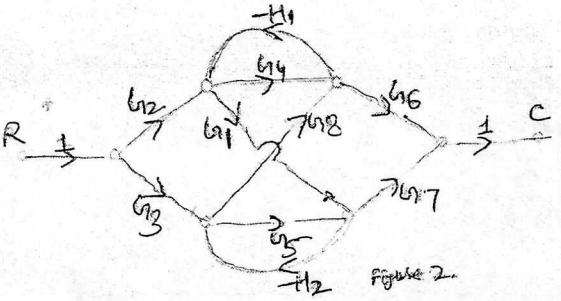

Figure 2.

Q. 2. In a position control system the forward path transfer function is $\frac{100}{s(1+s)}$ and feedback path transfer function is 10. Determine the sensitivity of T with respect to the feed forward and feedback elements respectively in the vicinity of $\omega = 1\ rad/sec$. **[05]**

Q. 3. Find the transfer function C/R for the figure shown in Figure 2 using Signal flow graph technique. **[05]**

Q. 4. The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K}{s(1+sT)}$ where, T and K are constants having positive values. By what factor the amplifier gain be reduced so that (a) peak overshoot of unit step response of the system is reduced from 75% to 25%. (b) damping ratio increases from 0.1 to 0.6. **[05]**

Q. 5. A feedback control system is described as $G(s) = \frac{50}{s(s+2)(s+5)}$, $H(s) = \frac{1}{s}$

For a unit step input, determine the steady-state error constants and errors. **[05]**

Q. 6. Determine the values of K and b, so that the system whose open-loop transfer function is $G(s) = \frac{K(s+1)}{s^3+bs^2+3s+1}$ oscillates at a frequency of oscillations of 2 rad/sec. Assume unity feedback. **[05]**

Q. 7. Sketch the root locus plot for a control system represented by $G(s)H(s) = \frac{K}{s(s+2)(s^2+4s+8)}$ **[05]**

Q. 8. Draw the Bode plot for a system having $G(s)H(s) = \frac{100}{s(s+1)(s+2)}$, Find: (i) Gain Margin (GM), (ii) Phase Margin (PM), (iii) Gain crossover frequency (ω_{gc}), and (iv) Phase crossover frequency (ω_{pc}). **[05]**

Q. 9. Explain: (a) Briefly state the Nyquist criterion, (b) What does the Nyquist criterion tell us?, (c) What is a Nyquist diagram?, (d) Why is the Nyquist criterion called a frequency response method?, and (e) What is a Nyquist stability criterion condition? **[05]**

Q. 10. Explain the different types of compensators with suitable circuit diagram and find its transfer function. **[05]**

****** All the Best ******