S.E.(Instrumentation Engineering)(SEM-IV)(Choice Based) / Dec.2019/11.12.2019

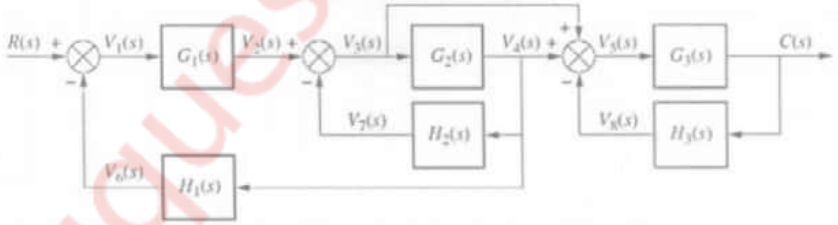
(3 Hours) (Total Marks : 80)

Instructions:

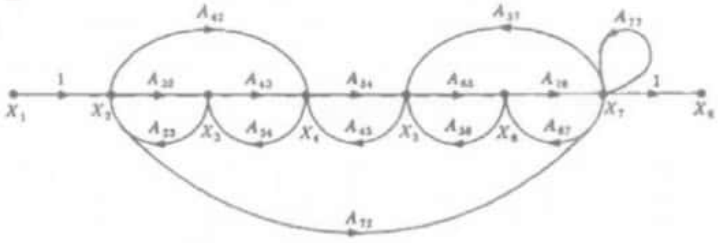
- **Q. No.1** is **compulsory**.
- Answer any **Three** out of remaining **Five** questions.
- Assumptions made should be **clearly stated**.
- Assume any suitable **data** wherever **required** but **justify the same**.
- **Figure** to the **right** indicate gets **full marks**.
- **Illustrate answers** with **sketches** wherever **required**.

1. **Attempt any four.** (20)
   - **a.** Explain the development of automatic control systems and classification of the control system with examples.
   - **b.** Derive the transfer function in canonical form of close loop system?
   - **c.** Define Gain and Phase margin of system.
     Also comment on stability of system based on GM and PM.
   - **d.** Describe time domain specifications.
     Define all with their mathematical expression.
   - **e.** Classify the feedback control system based on
     i. Nature
     ii. Time
     iii. Time behavior
     iv. Deterministic and stochastic
     v. Number of inputs and outputs
     vi. Feedback and feed forward system

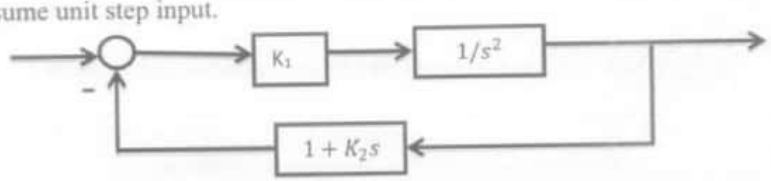
2. **a.** Examine unity feedback system having open loop transfer function (10)
   $G(s) = \frac{k(s+1)}{s(s^3+7s^2+12s)}$.
   Find :
   i. Type of system,
   ii. Error coefficients,
   iii. Steady state error when input to the system is $\frac{R}{2}t^2$.
   - **b.** Derive transfer function for following block diagram (10)



3. **a.** Solve following SFG and find transfer function. (10)



b. For a control system shown below, find the values of K_1 & K_2 so that M_p= 25% and T_p= 4sec. Assume unit step input. (10)



4. a. A unity feedback control system has an open loop transfer function. Construct the root locus plot of the system. Find the value of k and frequency at which the root loci cross the $j\omega$ axis. Comment on stability of the system. (10)

$$G(s) = \frac{k}{s(s^2 + 10s + 24)}$$

b. The characteristics equations for a certain feedback control system are given below. Evaluate the range of values of k for the system to be stable. (10)

i. $s^4 + 23s^3 + 8s^2 + 3s + k = 0$

ii. $s^4 + 7s^3 + 10s^2 + ks + k = 0$

5. a. Construct a bode diagram of an open loop transfer function $G(s)$. Determine GM, PM, ω_{gc}, ω_{pc}. Comment on stability of the system. (10)

$$G(s)H(s) = \frac{10(s+2)}{s(s+0.5)(s+10)}.$$

b. A unity feedback system has open-loop transfer function (10)

$$G(s) = \frac{1}{s(2s+1)(s+1)}$$

Sketch Nyquist plot for the system and from there obtain the gain margin and the phase margin.

6. a. Explain force voltage and force current analogy. (10)

b. Evaluate the differential equation for the mechanical system. (10)

Obtain the analogues electrical network based on the force voltage analogy.