B.E. Electrical (Electronics & Power) Engineering (Model Curriculum) Sem-V

TE105 : Control Systems

P. Pages : 3 **GUG/W/22/13868**

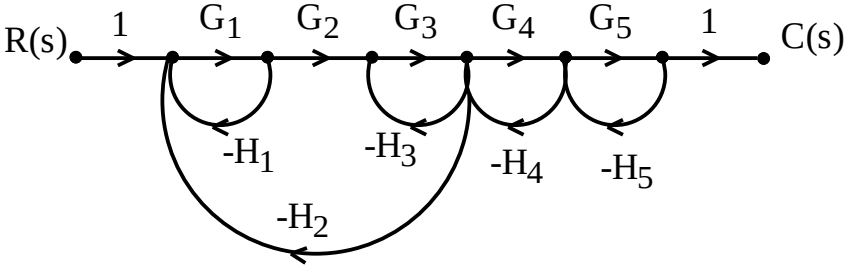
Time : Three Hours * 3 8 2 0 * Max. Marks : 80

Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of slide rule, Logarithmic tables, Steam tables, Moldier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
6. Use of Non-programmable calculator is permitted.

1. a) Compare open loop and closed loop system with suitable examples. **4**

b) Write the analogous electrical elements in force voltage analogy for mechanical System. **4**

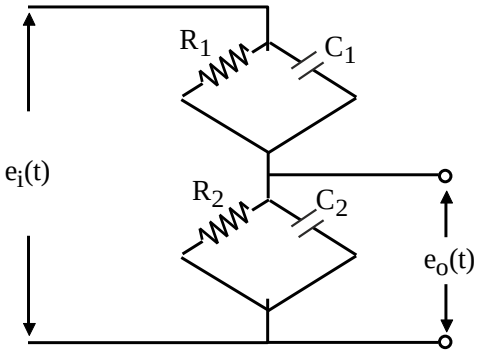
c) Obtain the overall transfer function C(S) /R(S) from the signal flow graph shown. **8**



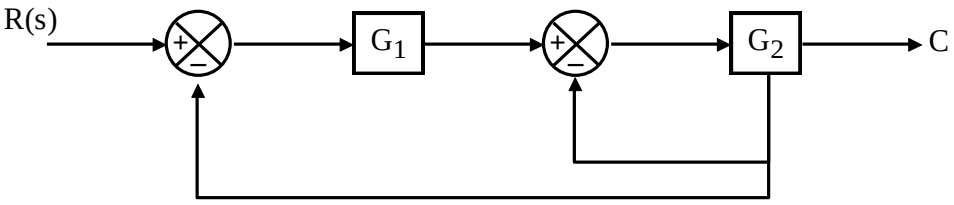
OR

2. a) Explain about mason's gain formula? **2**

b) Obtain the transfer function of the following electrical network. **7**



c) Determine the transfer function C(S)/R(S) of the system shown below fig. **7**



3. a) Explain error constants Kp, Kv and Ka for type I system. **6**

b) Define the following: **4**

i) time response ii) Transient response

iii) Steady state response iv) Delay time

c) For a unity feedback system whose open loop transfer function is **6**
G(s) = 50/(1+0.1s)(1+2s), find the position, velocity & acceleration error constants.

OR

4. a) Explain about various test signals used in control systems? **4**

b) Discuss the advantages and disadvantages of proportional, proportional derivative, proportional integral control system. **4**

c) A unity feedback system is characterized by an open loop transfer function **8**

$$G(s) = \frac{K}{S(S+10)}$$

Determine gain 'K' so that system will have a damping ratio of 0.5. For this value of 'K' determine settling time, peak overshoot and time to peak overshoot for a unit step input. Also obtain closed loop response in time domain.

5. a) Explain the steps for the construction of root locus? **8**

b) State Routh's stability criterion. **2**

c) Find the range of K for stability of the system with characteristic equation **6**

$$s^4 + 3s^3 + 3s^2 + 2s + K = 0$$

OR

6. a) Define the terms (i) Absolute stability (ii) marginal stability (iii) conditional stability (iv) stable system (v) Critically stable system (vi) conditionally stable system? **6**

b) Define BIBO Stability. What is the necessary condition for stability? **2**

c) Sketch the root locus for the system **8**

$$G(S)H(S) = \frac{K}{S\left(S^2 + 6S + 10\right)}$$

7. a) Define gain margin and phase margin? **4**

b) Write short notes on various frequency domain specifications. **4**

c) The open loop transfer function of a system is **8**

$$G(S) = \frac{K}{S(1+S)(1+0.1S)}$$

Determine the value of K such that (i) Gain Margin = 10dB and (ii) Phase Margin = 50 degree.

OR

8. a) Sketch the Bode plot for the open loop transfer function **8**

$$G(S)=\frac{10(S+3)}{S(S+2)\left(S^2+4S+100\right)}$$

b) Define frequency response & Explain Polar Plots? **8**
Draw the polar plot for open loop transfer function for unity feedback system

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

determine gain margin, phase margin?

9. a) Define state of a system, state variables, state space and state vector. Give Block Diagram representation of state Space Model. **8**

b) The State space representation of a System is given below: Obtain the transfer function **8**

$$X(t)=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}X(t)+\begin{bmatrix}2 & 1\\ 0 & 1\end{bmatrix}R(t)$$

$$Y(t)=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}X(t)$$

OR

10. a) A system variables for the state variable representation of the system **8**

$$A=\begin{bmatrix}-1 & 1\\ 1 & -2\end{bmatrix}, B=\begin{bmatrix}0\\ 1\end{bmatrix}, C=\begin{bmatrix}1 & 0\end{bmatrix}$$

Determine the complete state response and the output response of the system for the initial state $X(0)=\begin{bmatrix}-1\\ 0\end{bmatrix}$

b) Derive the expression for the calculation of the transfer function from the state variables for the analysis of system? **8**

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