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

TE105 - Control Systems

P. Pages : 3 | GUG/S/23/13868

Time : Three Hours | 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, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
6. Use of Non – programmable calculator is permitted.

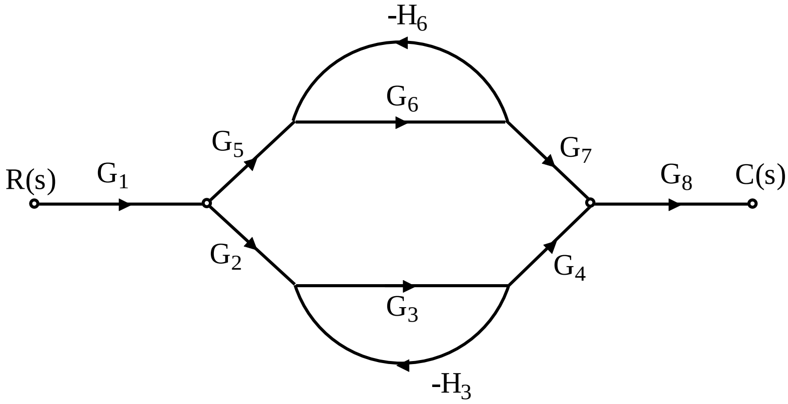
1. a) The poles of a real rational transfer function are given as 0, -1 and -4. There is a single zero (of order 2) at S = (-3). Determine the transfer function and plot pole zero on S - plane . **4**

b) Explain open loop & closed loop control systems by giving suitable Examples & also highlights their merits & demerits. **4**

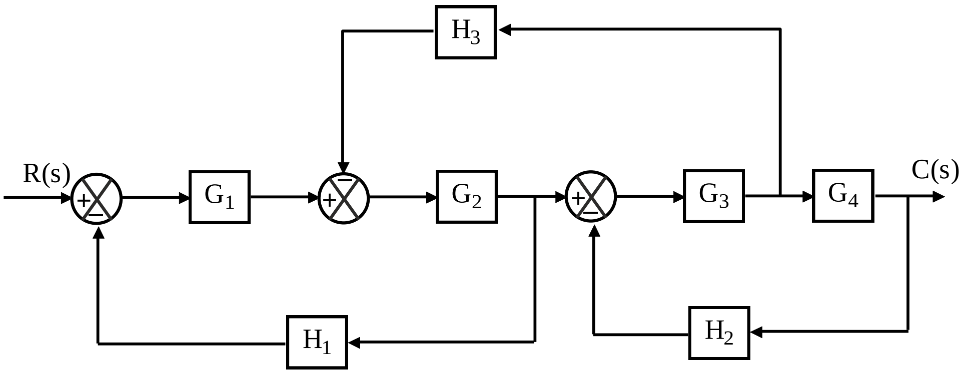
c) Discuss basis for framing the rules of block diagram reduction technique? What are drawbacks of the block diagram reduction technique? **8**

OR

2. a) Obtain the overall transfer function C/R from the signal flow graph shown. **8**



b) Determine the transfer function C(S)/R(S) of the system shown below fig. **8**



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

b) Define the following: **7**
i) Time response
ii) Transient response
iii) Steady state response
iv) Delay time
v) Rise time
vi) Peak time
vii) Settling time.

c) Explain about various test signals used in control systems? **5**

OR

4. a) A unity feedback system has $G(s) = \frac{40(s+2)}{s(s+1)(s+4)}$ Determine i) Type of the system ii) All error coefficients and iii) Error for the ramp input with magnitude 4 **8**

b) 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) The system having characteristics equation $2s^4 + 4s^2 + 1 = 0$ **8**
i) The number of roots in the left half of s - plane.
ii) The number of roots in the right half of s - plane.
iii) The number of roots on imaginary axis use RH stability criterion.

OR

6. a) Define the terms **6**
i) Absolute stability.
ii) Marginal stability
iii) Conditional stability
iv) Stable system
v) Critically stable system.
vi) Conditionally stable system?

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

c) Sketch the root locus for the system: **8**
$$G(S)H(S) = \frac{K}{s(s^2+6s+10)}$$

7. a) Explain Gain cross - over frequency and phase cross - over frequency? **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) Draw the polar plot for open loop transfer function for unity feedback system **8**

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

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. **6**

b) Derive the expression for the calculation of the transfer function from the state variables for the analysis of system? **6**

c) Explain Advantages of state space variable method over Transfer Function. **4**

OR

10. a) A system is described by the following differential equation. Represent the system in state space: **8**

$$\frac{d^3X}{dt^3}+3\frac{d^2X}{dt^2}+4\frac{dX}{dt}+4X=u_1(t)+3u_2(t)+4u_3(t)$$

And outputs are

$$y_1=4\frac{dX}{dt}+3u_1$$

$$y_2=\frac{d^2X}{dt^2}+4u_2+u_3$$

b) The state space representation of a system is given below: Obtain the transfer function. **8**

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

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

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