**R18**

**Code No: 155AR**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech III Year I Semester Examinations, March - 2024**

**CONTROL SYSTEMS**

**(Common to ECE, EIE)**

**Time: 3 Hours** **Max. Marks: 75**

**Note:** i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A**

**(25 Marks)**

1.a) What is the advantage of closed loop control system over open loop control system. [2]

b) What is meant by feedback? What are the effects of feedback? [3]

c) What is the difference between type and order of the system? [2]

d) A Servo mechanism has its moment of inertia $J=10\times10^{-6}$ Kg-m$^2$, retarding friction $B=400\times10^{-6}$ N-m/ (rad/sec) and elasticity coefficient K=0.004 N-m/rad. Find the natural frequency, damping factor? [3]

e) What is the principle of argument? [2]

f) Define gain cross over frequency and phase cross over frequency. [3]

g) What is PI-controller and what are its effect on system performance? [2]

h) What is lead compensator? Write the transfer function of lead compensator? [3]

i) What are the advantages of state space analysis over transfer function analysis? [2]

j) Define Controllability and Observability. [3]

**PART – B**

**(50 Marks)**

2. Define Transfer Function. Find the Transfer function of the system shown in figure 1 by using Block Diagram Reduction Technique. [10]

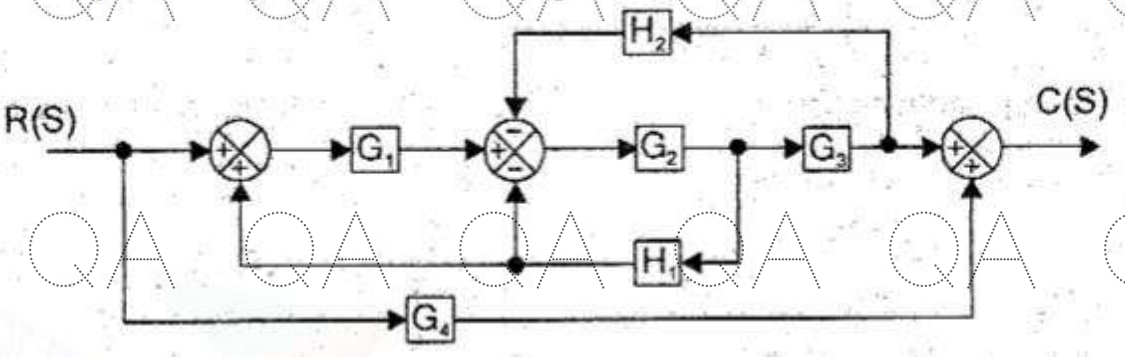


Figure 1

**OR**

3. Find the Transfer function of the system whose signal flow graph is shown in below figure 2. [10]

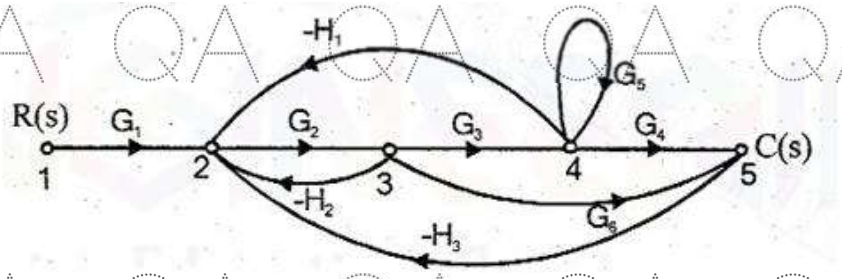


Figure 2

4.a) Derive the expression for Time response of the first order system for unit step-input.

b) The unity feedback system is characterized by an open loop transfer function G(S) = K/S(S+10). Determine the gain K, so that the system will have a damping ratio of 0.5 for this value of K. Determine peak time, settling time and peak overshoot. [5+5]

**OR**

5.a) The OLTF of a unity feedback system is given by G(S) = K/(S+2)(S+4)($S^2$ +6S+25) by applying Routh criteria discuss the stability of the system as a function of K. Determine the value of K, which will cause sustained oscillations in the close loop system and the value of oscillating frequency.

b) What is the effect of adding pole and zero on root locus? [6+4]

6. Sketch the Bode plot for the unity feedback system whose open loop transfer function is G(S)= K $e^{-0.2S}$ /S(S+2) (S+8). Find K, so that the system is stable with (a) Gain margin = 6dB, (b) Phase margin = $45^0$. [10]

**OR**

7. Sketch the Polar plot and determine the Gain margin for the following transfer function G(S) =1/$S^2$ (1+S) (1+2S). [10]

8. Explain about Root-loci method of feedback controller design. [10]

**OR**

9. Explain the procedure for the design of lag compensator in frequency domain. [10]

10.a) Obtain the state model of the system whose transfer function is given as Y(S)/U(S) = 10(S+4)/S(S+1)(S+3).

b) Write the solution of Homogeneous State Equation. [6+4]

**OR**

11.a) What are the properties of state transition matrix?

b) Find the Eigen values of a matrix given by [5+5]

$$A=\begin{bmatrix} 1 & 0 & 0 \\ 0 & -3 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

**---ooOoo---**