(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2112 **Roll No.** | | | | | | | | | | |

B.Tech.

(SEM. V) THEORY EXAMINATION 2011-12

CONTROL SYSTEM

Time : 3 Hours *Total Marks : 100*

Note :— All questions carry equal marks.

1. Answer any **four** parts of the following : **(5×4=20)**

   (a) What do you understand by "OPEN LOOP" and "CLOSED LOOP" control systems ? Discuss the comparative statements between open loop and closed loop control systems. Also mention the practical examples of open and closed loop control systems.

   (b) What do you mean by "ANALOG" and "DIGITAL" control systems ? What are the advantages/disadvantages of digital control systems over analog control systems ?

   (c) Define the following terms in regarding with signal flow graph :–

      (i) FORWARD PATH

      (ii) DUMMY Node

(iii) Non-Touching Loops

(iv) Loop gain

(v) Source and Sink node.

(d) Consider the signal flow graph as shown in Fig. 1.

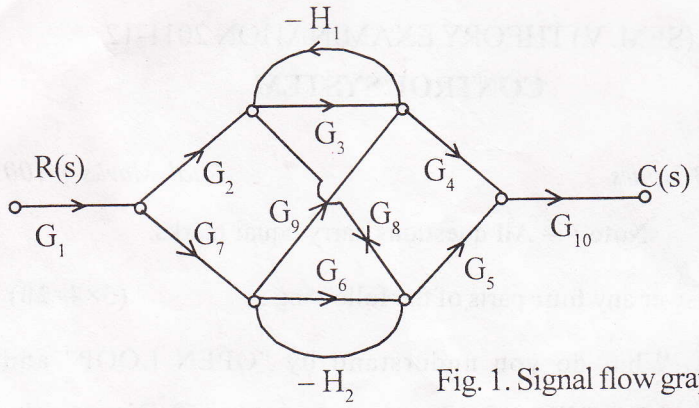

Fig. 1. Signal flow graph

Find $\frac{C(s)}{R(s)}$ by Mason's gain formula.

(e) Consider the block diagram as shown in Fig. 2

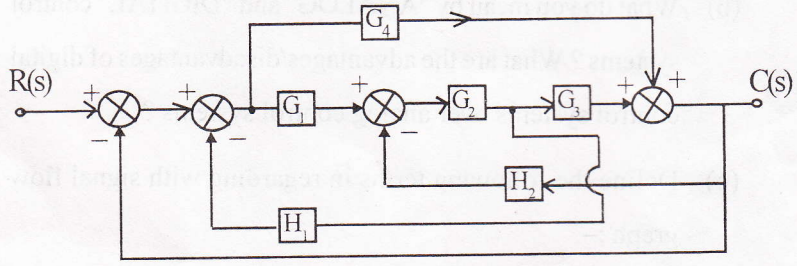

Fig. 2

Find $\frac{C(s)}{R(s)}$ by block diagram reduction technique.

(f) What is block diagram representation ? Explain with a suitable examples. Also mention its advantages and disadvantages. Explain the block diagram reduction rules.

2. Answer any **two** parts of the following : **(10×2=20)**

(a) The response of a system subjected to a unit step input is

$$C(t) = 1 + 0.2\, e^{-60t} - 1.2\, e^{-10t}$$

Obtain the expression for the closed loop transfer function. Also determine the undamped natural frequency and damping ratio of the system.

(b) Fig. 3(a) shows a mechanical vibratory system. When a force of 8.9 N is applied to the system, the mass oscillates as shown in the Fig 3(b). Find the values of M, B and K.

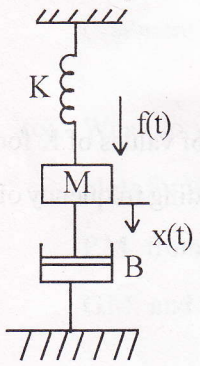

Fig. 3 (a)

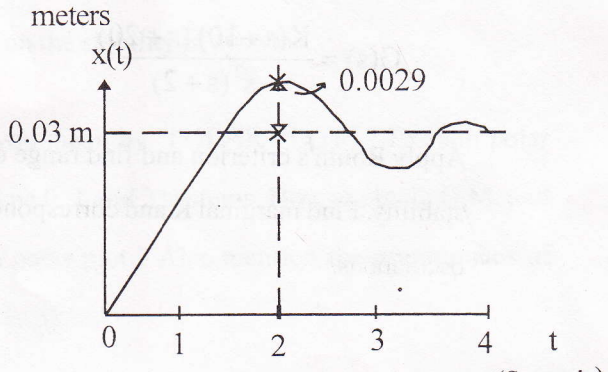

Fig. 3 (b)

(c) Find K_p, K_v and K_a and steady state error for a system with open loop transfer function as :

$$G(s)\,H(s) = \frac{10(s+2)(s+3)}{s(s+1)(s+5)(s+4)}$$

where the input is

$r(t) = 3 + t + t^2$.

3. Answer any **two** parts of the following : **(10×2=20)**

(a) Determine the range of value of $K(K > 0)$ such that the characteristics equation

$s^3 + 3(K + 1)s^2 + (7K + 5)s + (4K + 7) = 0$

has roots more negative that $s = -1$.

(b) For a unity feedback system,

$$G(s) = \frac{K(s+10)(s+20)}{s^2(s+2)}$$

Apply Routh's criterion and find range of values of K for stability. Find marginal K and corresponding frequency of oscillations.

(c) Sketch the root locus for the system having :

$$G(s)\ H(s) = \frac{K}{s(s^2 + 2s + 2)}.$$

Answer any **two** parts of the following : **(10×2=20)**

(a) What do you mean by "FREQUENCY DOMAIN ANALYSIS" ? Derive the correlation between time and frequency domain specifications. Explain why frequency domain analysis is more superior than time domain analysis ?

(b) Sketch the Nyquist plot for system with

$$G(s)\ H(s) = \frac{(1 + 0.5\,s)}{s^2(1 + 0.1\,s)(1 + 0.02\,s)}$$

Comment on the stability of system.

(c) What do you mean by "POLAR PLOT" ? Explain polar plots for type 0, 1 and 2 systems. How to obtain G.M. and P.M. from polar plot ? Also mention the importances of G.M. and P. M.

5. Answer any **two** parts of the following : **(10×2=20)**

(a) What do you understand by "COMPENSATION" in control systems ? What are the different types of compensators used in control systems ? Also mention their importances in control systems.

(b) Design a suitable lag compensator for a system with

$$G(s) = \frac{1}{s\,(s+1)\,(1+0.5\,s)}$$ to meet

the following specifications :

(i) $K_v \geq 5\ sec^{-1}$

(ii) P.M. $\geq +40°$

(iii) G.M. $\geq +10$ db

(c) Define the following in conjunction with state variable analysis :–

(i) State

(ii) State variables

(iii) State vector

(iv) State space

(v) State Trajectory

Also mention the advantages and limitations of state variable analysis.