

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

PAPER ID : 2112

Roll No.

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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.

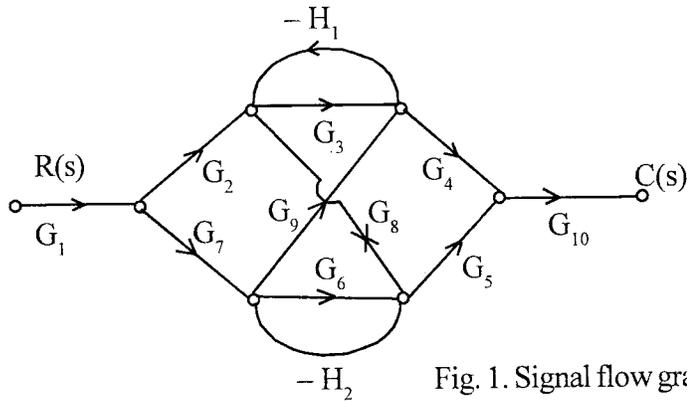


Fig. 1. Signal flow graph

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

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

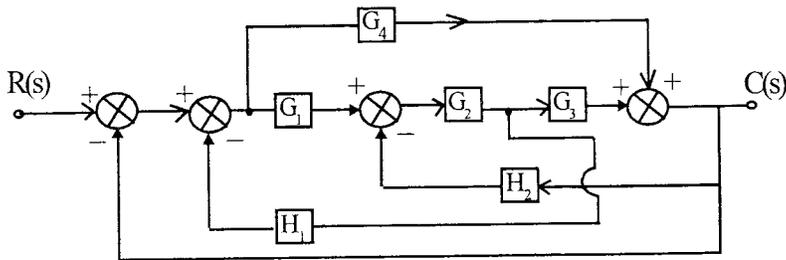


Fig. 2

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)**

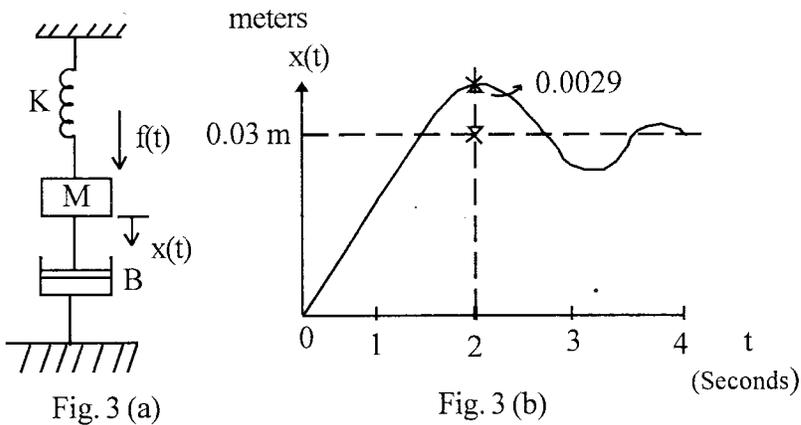
(a) The response of a system subjected to a unit step input is

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

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.



- (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 than $s = -1$.

- (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

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

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

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

the following specifications :

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

(ii) P.M. $\geq + 40^\circ$

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

(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.