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

Paper ID : 132521 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. V) THEORY EXAMINATION. 2015-16

CONTROL SYSTEMS-I

[Time:3 hours] **[Total Marks:100]**

SECTION-A

1. Attempt **all** parts. All parts carry equal marks. Write answer of each part in short. (2×10=20)

(a) Give two advantages of block diagram representation of a control system.

(b) Write the transfer function of an armature controlled d.c. motor relating angular displacement with applied voltage Va.

(c) Write the expression for the transfer matrix.

(d) Give the state equations and output equations for a LTI system.

(e) Explain what is Transient response?

(f) Draw the location of roots of characteristic equation and time response for a second order system for various values of damping ratio.

(g) Explain what is zero state response?

(h) In a Routh array if all elements in the intermediate row become zero. What is the damping ratio?

(i) What is the general effect of adding a zero to the forward path transfer function?

(j) Explain gain crossover frequency in Nyquist plot.

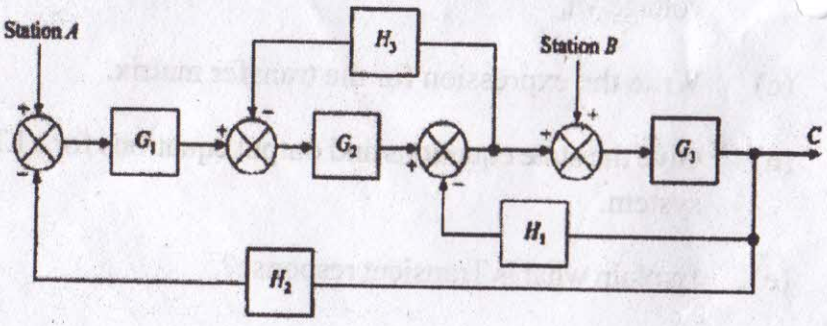
SECTION-B

Attempt **any five** questions from this section. (10×5=50)

2. Evaluate the closed loop transfer function for the system represented by block diagram given below when the input R is

   (i) at station A

   (ii) at station B.



3. Define the following SFG terms :

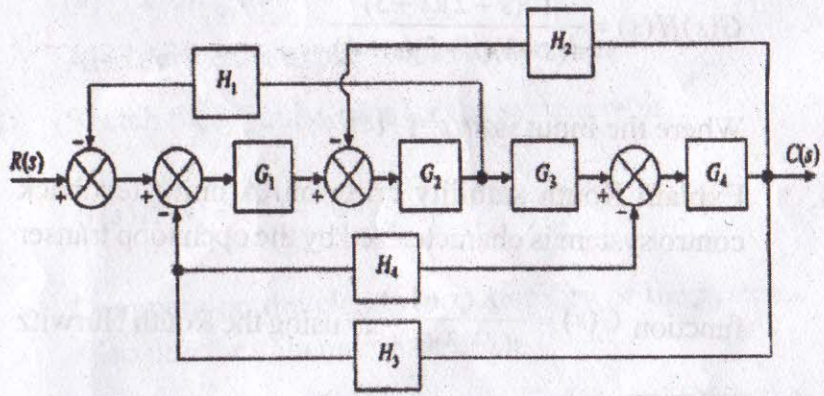
   (a) Node

   (b) Branch

   (c) Closed path

   (d) Output Node

   Find the closed loop transfer function of the system given below using mason's gain formula.



4. Explain the concept of state and state vector. Also construct signal flow graph and state model for a system whose transfer function is:

$$\frac{Y(s)}{U(s)} = \frac{6s^3 + 4s^2 + 3s + 10}{s^3 + 8s^2 + 4s + 20}$$

5. What is state transition matrix. Give the Laplace transform method of computing the state transition matrix. Also give the properties of state transition matrix with proof.

6. What is steady state error? Give the steady state error caused by non linear elements.

7. Find Kp, Kv, Ka 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 $r(t)=3+t+t^2$

8. Explain Routh stability criterion. A unity feedback contro system is characterized by the open loop transer function $G(s)=\frac{K(s+13)}{s(s+3)(s+7)}$ using the Routh Hurwitz criterion.

(i) Calculate the range of values of K for the system to be stable.

(ii) What is the marginal value of K for stability? Determine the frequency of oscillations if any.

9. Determine the expression for resonant peak and resonant frequency for a second orter system.

SECTION-C

Attempt **any two** questions from this section. (15×2=30)

10. Define the following terms:

(i) Delay Time

(ii) Rise Time

(iii) Peak Time

(iv) Peak Overshoot

(v) Settling time

Also derive the expressions for rise time?

11. Sketch the Nyquist plot for the system with

$$G(s)H(s)=\frac{10(s+3)}{s(s-1)}$$

Comment on the closed loop stability of the system. Also find the gain margin in dB.

12. Explain the steps for drawing the bode plots. Draw the bode plot for the transfer function :

$$G(s)=\frac{20}{s(1+0.1s)}$$

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