C 1106

(Pages : 4)

Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) [09 SCHEME] DEGREE EXAMINATION, APRIL 2016

EC / PTEC 09 604—CONTROL SYSTEMS

Time : Three Hours

Maximum : 70 Marks

(Semilog sheet and graph sheet need to be supplied)

Part A

Answer **all** *questions.*

1. Define poles and zeros of a system.
2. The damping ratio of a system is 0.75 and the natural frequency of oscillation is 12 rad/sec. Determine the peak overshoot and peak time.
3. Mention the advantages of frequency response analysis.
4. What is pulse transfer function ?
5. Mention the properties of state transition matrix.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. Obtain the differential equation of the following mechanical system shown in Fig. 6.

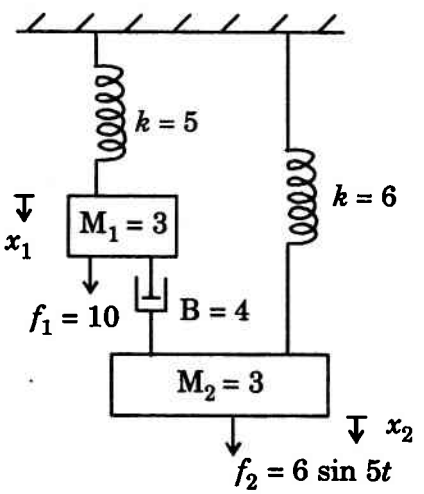

Fig. 6

Turn over

7. Compare block diagram and signal flow graph reduction techniques.

8. Discuss the effect of integral plus derivative control on transient response of the system.

9. Derive the expression for unit response of a second order underdamped system

$$G(s) = \frac{\omega_n^2}{s^2 + 2\xi\omega n s + \omega_n^2}$$

10. Draw and explain the zero order hold circuit with wave forms.

11. Find the state observability of the system described by :

$$\dot{x} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u \quad y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} x.$$

(4 × 5 = 20 marks)

Part C

Answer **all** *questions.*

12. (a) Obtain the transfer function of the following system in Fig. 12 (a) using signal flow graph technique.

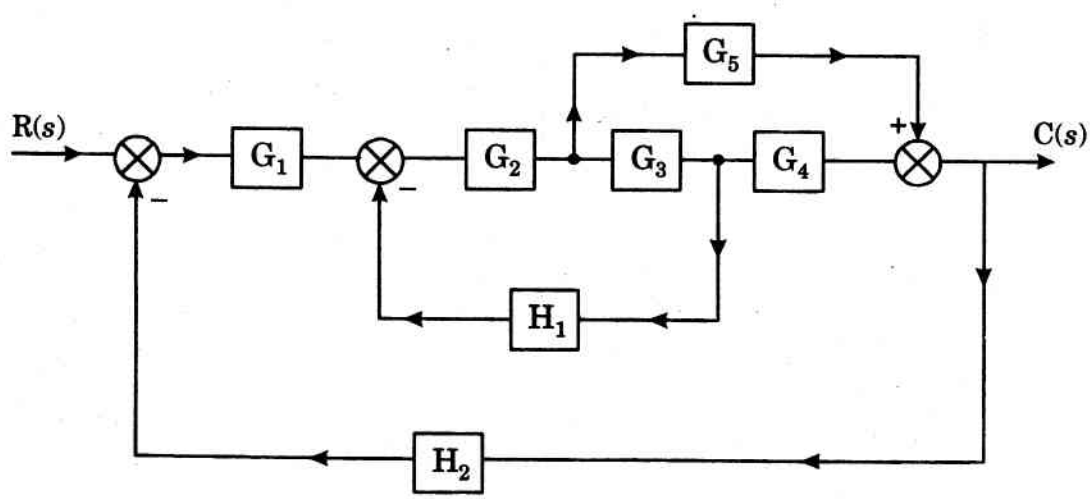

Fig. 12 (a)

Or

(b) Derive an expression for the transfer function of an armature controlled d.c. servomotor.

13. (a) Sketch Bode plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec.

$$G(s) = \frac{Ks^2}{(1+0.2\,s)(1+0.02s)}$$

Or

(b) Sketch the root locus for the system and comment on stability.

$$G(s)\,H(s) = \frac{K(s+4)(s+5)}{(s+3)(s+1)},\ K > 0.$$

14. (a) (i) State and prove five properties of Z-transform. (6 marks)

(ii) Find the Z-transform of $f(t) = te^{-at}$. (4 marks)

Or

(b) Test the stability of the system

$$F(z) = 2z^4 + 5z^3 + 10z^2 + 2z + 1$$

using Jury's method and Routh's criterion.

15. (a) Determine the transfer matrix from the data given below :

$$A = \begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix} B = \begin{bmatrix} 1 \\ 1 \end{bmatrix} C = [1 \quad 1]\ D = 0.$$

The transfer of a control system is given by

$$\frac{Y(s)}{U(s)} = \frac{s+2}{s^3 + 9s^2 + 26s + 24}.$$

Check for controllability.

Or

(b) (i) Explain in detail the state space representation of discrete time systems. (5 marks)

(ii) Obtain the homogeneous solution of the equation $x(t) = Ax(t)$

where $A = \begin{bmatrix} -9 & 1 \\ -14 & 0 \end{bmatrix}$ and $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$.

(5 marks)

(4 × 10 = 40 marks)