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Question Paper Code : 57450

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Electrical and Electronics Engineering

IC 6501 – CONTROL SYSTEMS

(Common to Electronic and Instrumentation Engineering & Instrumentation and Control Engineering)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

(Use to Graph Sheet, Semi log sheet Polar sheet is Permissible)
Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. What are the basic elements in control systems ?
2. Define Synchros.
3. List the time domain specifications.
4. State the effect of PI-controller on the system performance.
5. Define phase and gain cross over frequencies.
6. What is Lag-Lead compensation ?
7. What is a characteristic equation ?
8. Define Nyquist stability criterion.
9. What is meant by state space ?
10. When a system is said to be completely observable ?

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Compare open and closed loop control systems. **(4)**

(ii) Write the differential equations governing the mechanical rotational system as shown in Fig. 11(a). Draw the both electrical analogous circuits. **(12)**

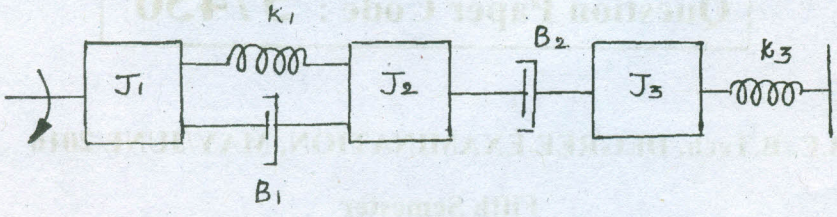

Fig. 11(a)

OR

(b) (i) Convert the given block diagram shown in Fig. 11(b) (i) to signal flow graph for and determine the closed loop transfer function C(s)/R(s). **(12)**

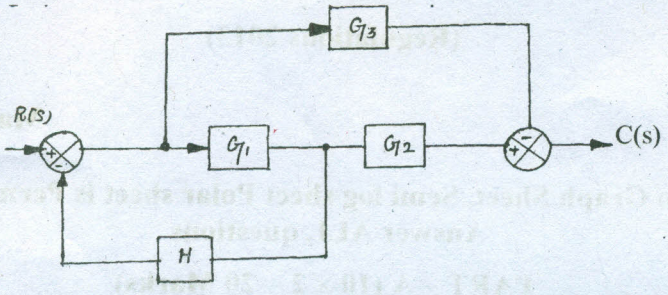

Fig. 11(b) (i)

(ii) Differentiate DC and AC servo motor. **(4)**

12. (a) Derive the time domain specifications of a second order system. **(16)**

OR

(b) (i) For a Unity feedback control system, the open loop transfer function is given by

$$G(S) = \frac{10\,(S+2)}{S^2\,(S+1)}$$

(1) Find the position, velocity and acceleration error co-efficients.

(2) Also find the steady state error when the input is

$$R(S) = \frac{3}{S} - \frac{2}{s^2} + \frac{1}{3\,s^3}$$ **(12)**

(ii) With a neat diagram explain the efect of PD controller in detail. **(4)**

13. (a) Plot the Bode diagram for the following transfer function and determine the Phase and gain cross over frequencies.

$$G(S) = \frac{10}{S\,(1 + 0.4\,S)\,(1 + 0.1S)}$$ **(16)**

OR

(b) The open loop transfer function of a unity feedback system is given by

$$G(S) = \frac{1}{S(1 + S)^2}$$

Sketch the polar plot and determine the gain and phase margin. **(16)**

14. (a) (i) Use R- H criterion to determine the location of the roots and stability for the system represented by Characteristic Equation

$$s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$$ **(8)**

(ii) Write the procedure for the design of Lag compensator using Bode plot. **(8)**

OR

(b) Draw the Nyquist plot for the system whose open loop transfer function

$$G(S)\,H(S) = \frac{K}{S(S + 2)\,(S + 10)}$$

Determine the range of K for which closed loop system is stable. **(16)**

15. (a) (i) With a neat block diagram, derive the state model and its equations of a Linear multi-input-multi-output system. **(10)**

(ii) Consider the system defined by (6)

$$X = Ax + BU$$

$$Y = Cx$$

Where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}; C = [10 \ 5 \ 1]$$

Check the complete Controllability of the system.

OR

(b) (i) The state model of a system defined by

$$x = Ax + Bu$$

$$y = Cx$$

Where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}; C = [1 \ 0 \ 0]$ (12)

Obtain the diagonal canonical form of the state model by a suitable transformation matrix.

(ii) Explain about the effect of state feedback. (4)
