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Question Paper Code : 10810

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

Fourth Semester

Instrumentation and Control Engineering

IC 8451 – CONTROL SYSTEMS

(Common to Electrical and Electronics Engineering/Electronics and Instrumentation Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Semilog sheet can be permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Identify the open loop system and closed loop system from the following example
   (a) Traffic Signal
   (b) DC motor speed control
   (c) Electric lift
   (d) Radar Tracking system

2. Despite the presence of negative feedback, control systems still have problems of instability, Why?

3. Define delay time and rise time.

4. Give the expression for the step response of the second order system subjected to a unit step input.

5. List the advantages of frequency response analysis.

6. What do you mean by minimum phase transfer function?

7. Justify the necessity of compensator to be introduced in a system.

8. If the repeated poles of a system lie on the imaginary axis of the s-plane, comment on the system stability and sketch its response.

9. What are the limitations of transfer function based modeling of system?

10. Mention the properties of state transition matrix.

PART B — (5 × 13 = 65 marks)

11. (a) (i) With the help of suitable example of any one of the physical system, illustrate the procedure for determining the transfer function. (7)

(ii) Elaborate the effects of feedback on the performance of the system. (6)

Or

(b) Obtain the overall transfer function relating C(s) of R(s) for the block diagram shown in the figure 11(b).

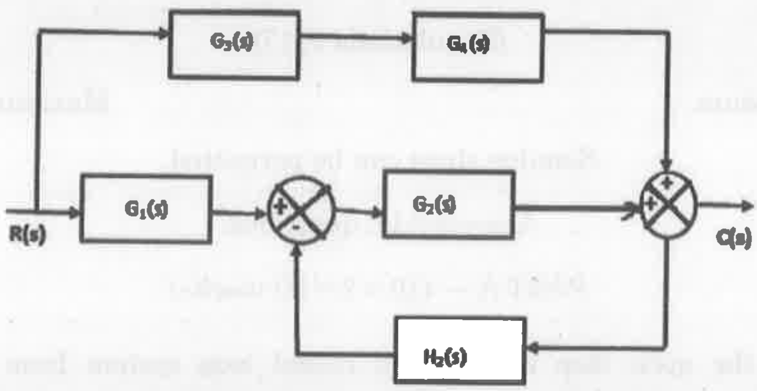

Fig 11(b)

12. (a) (i) Identify the type and static error coefficients of the system shown in the figure 12(a). Determine the transient response of the system for unit step input. (7)

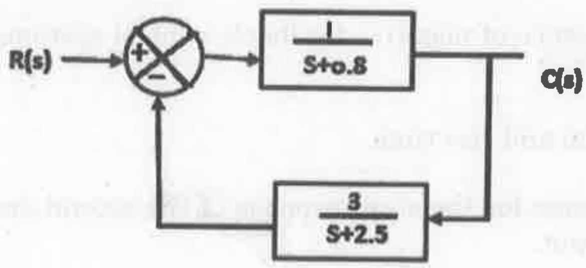

Fig 12(a)

(ii) Illustrate the various effects of P, PI and PID modes of feedback control. (6)

Or

(b) (i) Define steady state error and error constants with respect to unit step, unit velocity, unit acceleration inputs. How the steady state error can be reduced? (6)

(ii) Explain the steps and rules to construct the root locus for the given system. (7)

13. (a) Sketch the Bode plot for the transfer function of a system represented by

$G(s) = \dfrac{100(1+0.1s)}{(1+0.01s)(1+s)}$. Also find the position error constant.

Or

(b) Illustrate how the relationship exists between the time response and frequency response methods. Explain with an example.

14. (a) Derive the transfer function of the lag and lead compensator with suitable assumptions.

Or

(b) For the following characteristic equation $F(s) = s^4 + s^3 + 5s^2 + 4s + 4$. Find the location of the roots in the complex plane and determine the stability of the system.

15. (a) Consider the electrical circuit shown in the figure 15 (a). Obtain the state model of the system with zero initial condition where $e_i(t)$ and $e_0(t)$ are input and output voltages respectively.

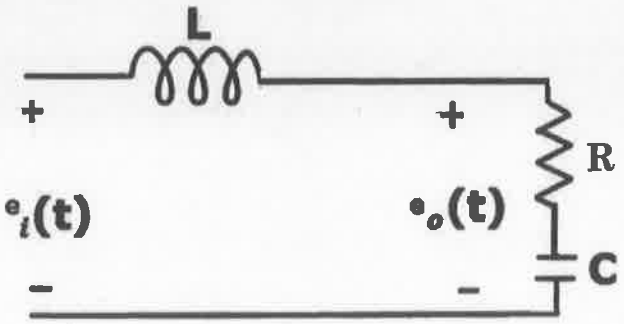

Fig. 15 (a)

Or

(b) Consider the following system with differential equation given by

$\dddot{y} = 6\ddot{y} + 11\dot{y} + 6y = 6u$.

Obtain the state model of the given system in a diagonal canonical form.

PART C — (1 × 15 = 15 marks)

16. (a) A certain feedback system has the following loop transfer function $GH(s) = \dfrac{K}{(1+sT_1)(1+sT_2)}$

Test the stability of the closed loop system using Nyquist stability criterion. Assume K, T_1 and T_2 are all positive.

Or

(b) Consider the system defined by

$$\dot{x} = Ax + Bu$$

$$y = Cx$$

Where,

$$A = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$$

$$B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \text{ and } C = \begin{bmatrix} 10 & 5 & 1 \end{bmatrix}$$

Check the system for (i) complete state controllability and (ii) complete observability.