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Question Paper Code : 60805

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Fourth Semester

Instrumentation and Control Engineering

IC8451 — CONTROL SYSTEMS

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

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

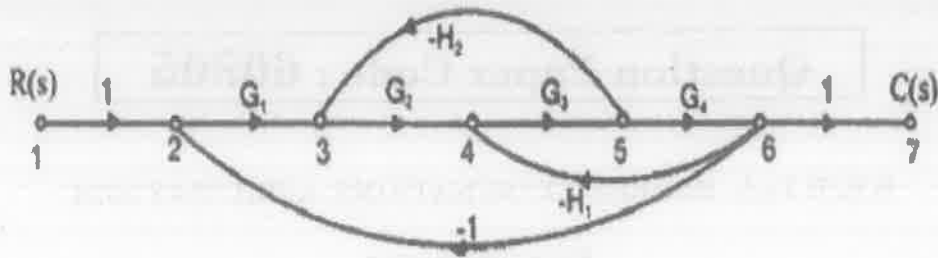
1. Differentiate open loop and closed loop systems.
2. Apply block diagram rule and move the branch point after the block G.



3. List the time domain specifications.
4. State the effect of PID in feedback control.
5. Correlate time domain and frequency domain specifications.
6. Write the steady state error equation.
7. List any two limitations of Routh-stability criterion.
8. State the effect of adding zero to a system.
9. With an example, define state and state variable.
10. Write the properties of state transition matrix.

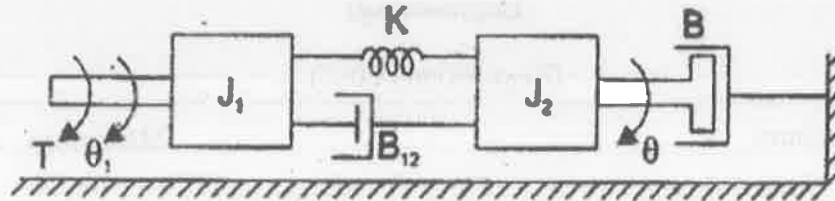
PART B — (5 × 13 = 65 marks)

11. (a) Find the overall gain using signal flow graph.



Or

- (b) Write the differential equations for the given mechanical system. Derive the transfer function.



12. (a) Sketch Root locus whose forward transfer function is

$$G(s) = \frac{s+1}{s(s^2+5s+20)}$$

Or

- (b) A unity feedback control system has an open loop transfer function $G(s) = 10/s(s+2)$. Find the rise time, peak time and settling time and draw the time response by plotting the obtained t_r , t_p and t_s values.

13. (a) Sketch Bode plot for the given transfer function.

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

Or

- (b) Sketch polar plot for the given transfer function $G(s) = \frac{1}{s(1+s)(1+2s)}$.

Find the gain margin and phase margin.

14. (a) (i) Examine the stability of the system whose characteristic equation is given by $s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$ using Routh-Hurwitz criterion. (6)

- (ii) A open loop transfer function is given as $G(s) = \frac{(s+2)}{(s+1)(s-2)}$. Find the number of encirclements about $-1 + j0$. (7)

Or

- (b) Write the procedure for lag-lead compensator using Bode plot in detail.

15. (a) Given $A_1 = \begin{bmatrix} \sigma & 0 \\ 0 & \sigma \end{bmatrix}$; $A_2 = \begin{bmatrix} 0 & \omega \\ -\omega & 0 \end{bmatrix}$; $A_3 = \begin{bmatrix} \sigma & \omega \\ -\omega & \sigma \end{bmatrix}$; Compute state transition matrix.

Or

- (b) Examine the controllability and observability of a system having following coefficient matrices.

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \quad C^T = \begin{bmatrix} 10 \\ 5 \\ 1 \end{bmatrix}$$

PART C — (1 × 15 = 15 marks)

16. (a) The open loop transfer function of the uncompensated system is

$$G(s) = \frac{k}{s(s+2)}$$

Design a lead compensator for the system so that the static velocity error constant K_v is 10/sec, the phase margin is at least 35° .

Or

- (b) By use of the Nyquist criterion, discuss whether closed-loop systems having the following open-loop transfer function is stable or not. If not, how many closed loop poles lie in the right half of s plane?

$$G(s) = \frac{10}{s(s+1)(2s+3)}$$

