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Question Paper Code : 11295

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

Fifth Semester

Electrical and Electronics Engineering

EE3503 — CONTROL SYSTEMS

(Regulations 2021)

Time : Three hours

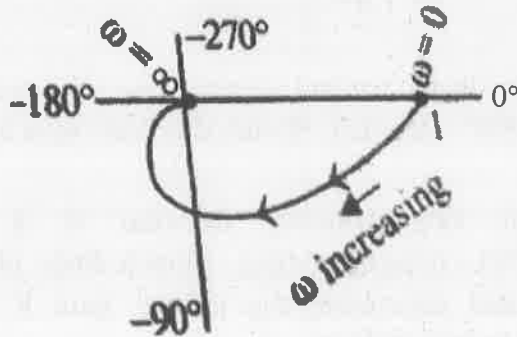
Maximum : 100 marks

(Use of Linear, Semi-Log and polar graph sheet are permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

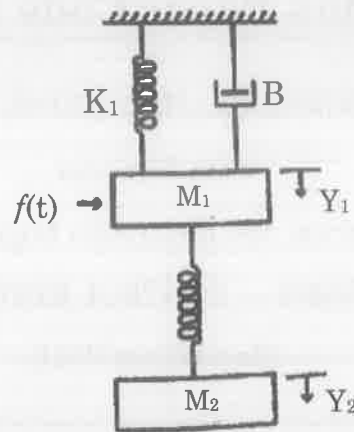
1. Define Transfer function modeling of the system and write its limitation.
2. Write the analogous electrical elements in force-voltage analogy for the elements of mechanical translational system.
3. How the system is classified depending on the value of damping ratio?
4. What are the necessary and sufficient condition for stability of a system?
5. List out the frequency domain specifications.
6. Determine the type and order of the system from the given polar plot.



7. What are the advantages of state space modeling analysis?
8. List the properties of state transition matrix.
9. Write the effect of PD controller on the system performance.
10. Mention the use of compensator and write its type.

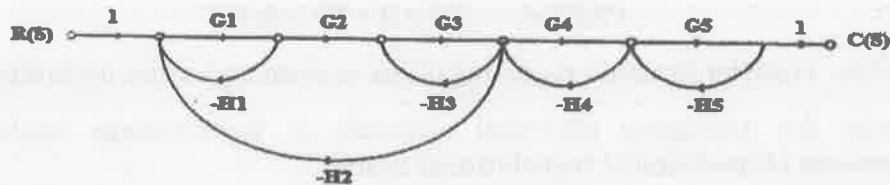
PART B — (5 × 13 = 65 marks)

11. (a) Determine the transfer function $Y_2(S)/F(S)$ of the system shown in figure and also draw the force-voltage electrical analogous circuit.



Or

- (b) Find $C(S)/R(S)$ for the signal flow graph shown below.



12. (a) Construct Routh array and determine the stability of the system represented by the characteristics equation is $S^7 + 9S^6 + 24S^4 + 24S^3 + 24S^2 + 23S + 15 = 0$. Comment on the location of the roots of characteristic equation.

Or

- (b) A unity feedback control system has an open loop transfer function, $G(S) = K/S(S^2 + 4S + 13)$. Sketch the Root locus and find the value of K .

13. (a) The open loop transfer function of a system is given by $G(s) = Ks^2/(1 + 0.2s)(1 + 0.02s)$. Sketch Bode plot for the given transfer function and determine the system gain k for the gain cross over frequency to be 5 rad/sec.

Or

- (b) Sketch the polar plot for the given open loop transfer function $G(s) = 1/s(1 + 2s)(1 + s)$. Determine the phase margin and gain margin.

14. (a) Construct a state model for a system characterized by the differential equation $\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y + 4 = 0$.

Or

- (b) Determine the controllability and observability of the system described

$$\text{by } \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -6 & -11 & -6 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u \quad y = \begin{bmatrix} 0 & 1 & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$

15. (a) Draw the schematic diagram of a lag compensator and with the help of root locus or bode plot, explain the design procedure of a Lag Compensator to improve transient response.

Or

- (b) (i) Explain the Ziegler-Nichols tuning methods for PID controller design. Describe the procedure of tuning using the Reaction Curve Method and the Ultimate Gain Method. (7)
- (ii) A process gives the following open-loop response to a step input, Dead time is 5 s, Time constant is 25 seconds. Using Ziegler-Nichols Reaction Curve Method, determine the PID controller parameters:
- (1) Proportional gain
 - (2) Integral time
 - (3) Derivative time (6)

PART C — (1 × 15 = 15 marks)

16. (a) A unity feedback system has an open loop transfer function $G(S) = K/S(S+8)$. Design a suitable lead compensator to meet the following specifications.
- (i) $K_v \geq 100$;
 - (ii) Phase margin $\geq 50^\circ$.

Or

- (b) Obtain state space representation for system, $y'' + 6y' + 5y = 0$. Also find state transition matrix $\phi(t)$.

