Reg. No.															

Question Paper Code	14367

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

Fourth Semester

Electronics and Instrumentation Engineering

(Common to Electronics and Communication Engineering , Electrical and Electronics Engineering & Electronics Instrumentation and Control Engineering)

24EIPC404 - CONTROL SYSTEMS

Regulations - 2024

(Use of *Ordinary, semilog and polar Graphs* is permitted)

Duration: 3 Hours Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	In control system block diagrams, which mathematical operation is performed at summing points? a) Addition or subtraction b) Multiplication c) Integration d) Differentiation	1	K2	CO1
2.	In Mason's Gain Formula, what is meant by a "non-touching loop" ? a) Two loops that share a node b) Two loops that do not share any common nodes c) Two loop vc s that share a branch d) Two loops with the same gain	1	K1	CO1
3.	In a mechanical system, what is the equivalent of resistance in an electrical system ? a) Mass b) Dashpot c) Spring constant d) Inertia	1	K3	CO1
4.	The unit impulse signal, δ(t) has a Laplace transform of: a) 1 b) 1/s c) s d) s^2	1	K2	CO2
5.	The time taken by a system response to reach 90% of its final value for the first time is called: a) Delay time b) Rise time c) Peak time d) Settling time	1	K3	CO2
6.	If the damping ratio (ζ) of a second-order system is greater than 1, the system is: a) Underdamped b) Critically damped c) Overdamped d) Undamped	1	K1	CO2
7.	A Bode plot shows the relationship between which of the following? a) Gain vs time b) Phase vs time c) Magnitude and phase vs frequency d) Magnitude and time vs frequency	1	K1	CO3
8.	Which of the following is applicable for a polar plot in frequency response analysis? a) The magnitude is plotted on the horizontal axis and phase on the vertical axis. b) It uses the Laplace transform to plot frequency response. c) It is primarily used to find the phase margin and gain margin. d) It shows the relationship between frequency and time-domain specifications.	1	K2	CO3

9.	What is the slope of the magnitude plot in dB/decade for a first-order system with a pole? a) +20 dB/decade b) -20 dB/decade c) +40 dB/decade d) -40 dB/decade	*1*	*K3*	*CO3*
10.	Which of the following methods is used to construct the root locus? a) Using the Bode plot b) Using the poles and zeros of the open-loop transfer function c) Using the Nyquist criterion d) Using the Routh-Hurwitz array	*1*	*K3*	*CO4*
11.	In root locus analysis, the number of branches of the root locus is equal to: a) The number of poles of the open-loop transfer function b) The number of finite zeros of the open-loop transfer function c) The difference between the number of poles and zeros of the system d) The number of imaginary poles in the system	*1*	*K2*	*CO4*
12.	The Routh-Hurwitz criterion is used to determine: a) The transient response of the system b) The frequency response of the system c) The stability of the system from the characteristic equation d) The dynamic response of the system	*1*	*K3*	*CO4*
13.	Which of the following compensators is designed to improve the phase margin and transient response by adding positive phase shift at high frequencies? a) Lag compensator b) Lead compensator c) Lag-Lead compensator d) Proportional compensator	*1*	*K1*	*CO5*
14.	What is the effect of a Lag-Lead compensator on the Bode plot? a) It increases phase margin and steady-state error simultaneously. b) It increases phase margin and reduces the steady-state error. c) It decreases phase margin but improves transient response. d) It increases bandwidth and reduces overshoot.	*1*	*K1*	*CO5*
15.	The Kalman test is used to check: a) Stability b) Controllability and Observability c) Time response d) Gain Margin	*1*	*K2*	*CO6*
16.	Lack of controllability implies: a) All states are controllable b) Some states cannot be controlled c) System is unstable d) Input is constant	*1*	*K3*	*CO6*

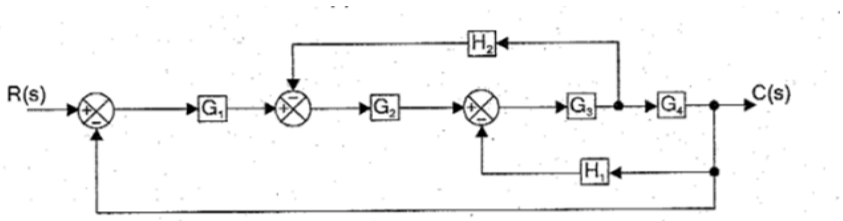
PART – A (ii) (Short Answer Questions)
(6 × 3 = 18 Marks)

Answer ALL Questions

17.	What are the basic elements used in mechanical translational and rotational systems?	*3*	*K3*	*CO1*
18.	List the test signals used in control system.	*3*	*K3*	*CO2*
19.	Draw the polar plot of $G(s)=1/s^3(1+sT_1)(1+sT_2)$.	*3*	*K4*	*CO3*
20.	Interpret centroid and angle of asymptotes.	*3*	*K3*	*CO4*
21.	Formulate the transfer function of a lag compensator.	*3*	*K4*	*CO5*
22.	Given the state model: $\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$ $y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$ Check for Observability.	*3*	*K3*	*CO6*

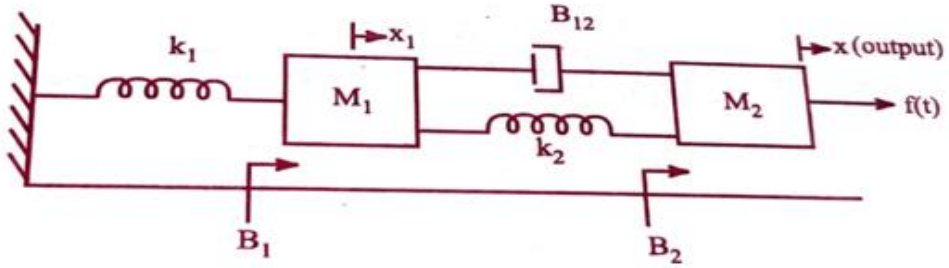
PART - B (Descriptive Answer Questions)
(6 × 11 = 66 Marks)
Answer ALL Questions

23.	a)	Using block diagram reduction techniques, find closed loop transfer function of the system whose block diagram is shown in fig.	*11*	*K3*	*CO1*



OR

	b)	Write the differential equations of the mechanical system shown in fig and determine the transfer function,	*11*	*K3*	*CO1*

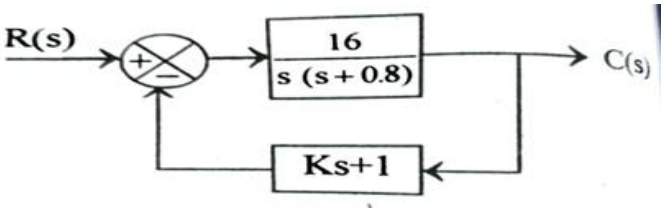


24.	a)	For a unity feedback control system, the open loop transfer function is given by Find the position, velocity and acceleration error co-efficients.	*11*	*K3*	*CO2*

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

OR

	b)	A positional control system with velocity feedback is shown in fig. What is the response of the system for unit step input. Given that $\zeta = 0.5$. Also calculate rise time, peak time, maximum overshoot and settling time.	*11*	*K3*	*CO2*



25.	a)	Sketch the polar plot for the following transfer function and find Gain margin and Phase margin.	*11*	*K4*	*CO3*

$$G(S) = 1/ S^2 (1+S) (1+2S)$$

OR

	b)	Sketch the bode plot for the unity fed back control system with transfer function:	*11*	*K4*	*CO3*

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

26. a) Sketch the Root locus of : *11 K3 CO4*

$$G(s)=\frac{K}{s\,(s^2+4s+13)}.$$

OR

b) Construct Routh array and determine the stability of the system whose characteristic equation is $s^4+8s^3+18s^2+16s+5=0$. Comment on the location of roots of the characteristics equation. *11 K3 CO4*

27. a) A system having an open loop transfer function of G(S)= k/s(1+2s) and H(S)=1. Design a suitable lag compensator such that the phase margin is greater than or equal to 40° and $e_{ss} = 0.2$ for ramp input. *11 K4 CO5*

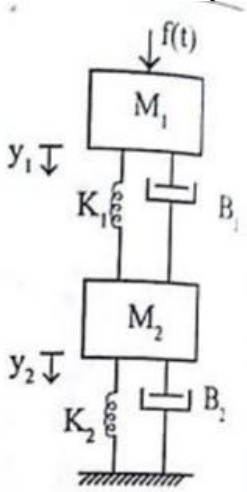
OR

b) Construct the procedure for design of lag –lead compensator using bode plot. *11 K4 CO5*

28. a) Test for Controllability and Observability using Kalman's Test. *11 K3 CO6*

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}-1 & 0 & 0\\ 0 & -2 & 1\\ 0 & 0 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}1\\ 0\\ 1\end{bmatrix}[u]$$

$$y=\begin{bmatrix}1 & 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

OR

b) Construct State model for the given Mechanical System. *11 K3 CO6*