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Question Paper Code	14229
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B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Fourth Semester

Electronics and Instrumentation Engineering

20ICPC401 - CONTROL SYSTEMS

Regulations - 2020

(Use of Ordinary, Semi log and Polar Graphs is permitted)

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

	<i>Marks</i>	<i>K- Level</i>	<i>CO</i>
1. In control systems, which of the following devices is typically used to convert mechanical motion into electrical signals? (a) Resistor (b) Potentiometer (c) Inductor (d) Transformer	1	K1	CO1
2. The method used to determine the overall transfer function from signal flow graphs? (a) Bode plot (b) Routh-Hurwitz criterion (c) Mason's gain formula (d) Root locus	1	K1	CO1
3. Which term describes the term a second-order system takes to reach its final value for the first time? (a) Rise time (b) Peak time (c) Delay time (d) Settling time	1	K1	CO2
4. A control system has high overshoot and slow settling time. Which of the following tuning changes would most likely improve performance? (a) Increase proportional gain (b) Add a zero to the transfer function (c) Introduce derivative action in the controller (d) Increase integral gain only	1	K1	CO2
5. The frequency at which the gain of a system becomes unity (0 dB) is called: (a) Phase crossover frequency (b) Cutoff frequency (c) Gain crossover frequency (d) Resonant frequency	1	K1	CO3
6. In a Bode plot, the magnitude plot of a first-order pole has a slope of: (a) +40 dB/decade (b) -40 dB/decade (c) -20 dB/decade (d) 0 dB/decade	1	K1	CO3
7. What does a sign change in the first column of a Routh array indicate? (a) Stable system (b) Number of zeros (c) Number of right half-plane poles (d) Phase margin	1	K1	CO4
8. Which of the following tools would you use to determine the gain for specified damping in root locus analysis? (a) Bode plot (b) Nyquist plot (c) Transfer function (d) Root locus diagram	1	K1	CO4
9. What is the primary purpose of lag compensator in control system design? (a) Improve transient response (b) Reduce noise (c) Improve steady-state error (d) Increase bandwidth	1	K1	CO5
10. Which compensator would you recommend for improving both transient and steady-state performance of a system? (a) Lead compensator (b) Lag compensator (c) Lag-Lead compensator (d) Integral controller	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

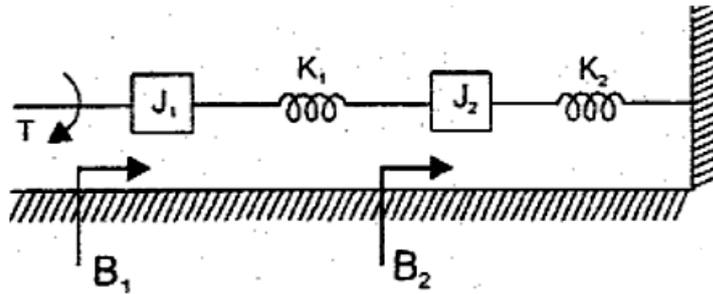
11. Why is negative feedback preferred in control systems?	2	K2	CO1
12. Write down Mason's Gain Formula and explain the meaning of each term.	2	K1	CO1
13. Mention the three basic elements in electrical and mechanical system.	2	K1	CO1
14. How does the addition of a pole, affect transient response of second-order system?	2	K2	CO2
15. Illustrate the significance of static error constants in evaluating steady-state error.	2	K2	CO2
16. Outline about generalized error series.	2	K2	CO2

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| 17. Summarize about phase margin, and why it is important in frequency domain analysis? | 2 | K2 | CO3 |
| 18. Draw the approximate polar plot for a Type 0 second order system | 2 | K1 | CO3 |
| 19. What are the necessary conditions for a system to be stable as per the Routh-Hurwitz criterion? | 2 | K1 | CO4 |
| 20. Show how Nyquist criterion can predict the number of unstable poles in a system. | 2 | K2 | CO4 |
| 21. What design advantage does a lead compensator offer in terms of system dynamics? | 2 | K1 | CO5 |
| 22. Recall the term Lag-Lead Compensation. | 2 | K1 | CO5 |

PART - C (6 × 11 = 66 Marks)

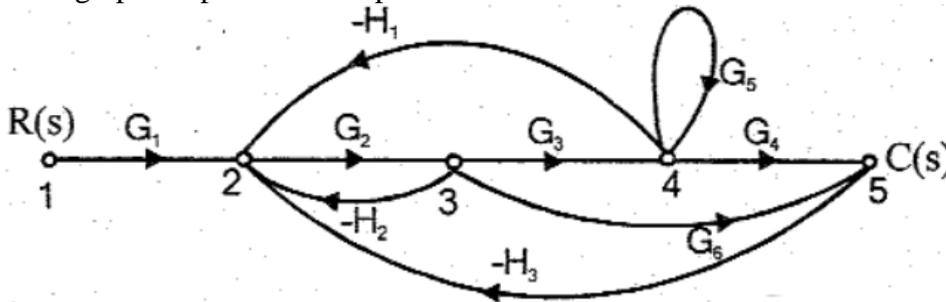
Answer ALL Questions

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| 23. a) | Derive the transfer function of a mechanical translational system consisting of mass, damper, and spring elements. Clearly state the assumptions used. | 11 | K3 | CO1 |
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OR

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| b) | Using Mason's Gain Formula, determine the overall transfer function for a given signal flow graph. Explain each step involved. | 11 | K3 | CO1 |
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| 24. a) | A unity feedback control system has transfer function $C(s) / R(s) = 16 / (S^2 + 1.6S + 16)$. The damping ratio is 0.8. Find the rise time, percentage overshoot, peak time and settling time. | 11 | K3 | CO2 |
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OR

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| b) | Explain the role and effects of P, PI, and PID controllers in time-domain response. Provide a comparison and sketch the typical response curves. | 11 | K3 | CO2 |
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| 25. a) | Plot the Bode diagram for the following transfer function and obtain the gain and phase margin. $G(S) = 75 (1+0.2s) / s(s^2+16s+100)$ | 11 | K3 | CO3 |
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OR

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| b) | Sketch the polar plot for the open loop transfer function of unity feedback system is given by $G(s) = 1 / s^2(1+s)(1+2s)$ and obtain the gain and phase margin. | 11 | K3 | CO3 |
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| 26. a) | For a system with the characteristic equation $s^4 + 2s^3 + 3s^2 + 4s + 5 = 0$, apply the Routh-Hurwitz criterion and determine its stability. | 11 | K3 | CO4 |
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| b) | Explain the construction and use of the root locus method. Sketch the root locus for a unity feedback system with open-loop transfer function $G(s) = K / s(s+2)(s+4)$. | 11 | K3 | CO4 |
|----|--|----|----|-----|

27. a) Design a lead compensator for a given system using Bode plot techniques to meet specified phase margin and gain crossover frequency. 11 K3 CO5

OR

b) Design a phase lag compensator for the given transfer function $G(s) = K / s (s+1) (s+4)$ with the unity feedback has specifications a) Phase Margin is 40° b) Steady state error $e_{ss} \leq 0.2$. 11 K3 CO5

28. a) A unity feedback system has an open-loop transfer function $G(s) = 10/s(s+2)$. Calculate the static error constants and find the steady-state error for a unit ramp input. 11 K3 CO2

OR

b) Differentiate between first-order and second-order system responses to a unit step input. Use suitable equations and graphs. 11 K3 CO2