B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Fourth Semester

Electrical and Electronics Engineering

20EEPC404 - CONTROL ENGINEERING

Regulations - 2020

(Use of Bode Plot, Polar Plot, Graph Sheets are permitted)

Duration: 3 Hours　　　　　　　　　　　　　　　　　　　　Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)
Answer ALL Questions

		Marks	K-Level	CO
1.	Nam the formula used to find the overall transfer function of a system from its signal flow graph? (a) Mason's Gain Formula　　　　　(b) Routh-Hurwitz Criterion (c) Nyquist Criterion　　　　　(d) Root Locus Method	1	K1	CO1
2.	In mechanical systems, torque corresponds to which quantity in electrical systems? (a) Voltage　　(b) Current　　(c) Resistance　　(d) Capacitance	1	K1	CO1
3.	The Laplace transform of a unit ramp signal is: (a) $1/s$　　(b) $1/s^2$　　(c) s　　(d) s^2	1	K1	CO2
4.	What is the steady-state error for a Type 0 system subjected to a step input? (a) Zero　　(b) Infinite　　(c) Constant, non-zero　　(d) Oscillatory	1	K1	CO2
5.	The Routh-Hurwitz criterion is used to determine which of the following in a system? (a) The time-domain response　　　　　(b) The frequency response (c) The stability of the system　　　　　(d) The open-loop transfer function	1	K1	CO3
6.	In the Nyquist stability criterion, if the Nyquist plot encircles the critical point (-1, 0) in the clockwise direction, the system is: (a) Stable　　(b) Unstable　　(c) Marginally stable　　(d) Indeterminate	1	K1	CO3
7.	Which of the following is NOT a frequency domain specification? (a) Resonant frequency　　　　　(b) Peak overshoot (c) Phase margin　　　　　(d) Gain margin	1	K1	CO4
8.	What is the gain margin? (a) The reciprocal of the magnitude of the open-loop transfer function at the phase crossover frequency (b) The magnitude of the open-loop transfer function at the gain crossover frequency (c) The phase shift of the open-loop transfer function at the gain crossover frequency (d) The phase shift of the open-loop transfer function at the phase crossover frequency	1	K1	CO4
9.	Which of the following is the primary function of a Lag-Lead compensator? (a) To increase the system's phase margin and decrease the settling time simultaneously (b) To improve the system's steady-state error and transient response (c) To increase the phase margin while maintaining a low steady-state error (d) To increase the bandwidth and reduce overshoot	1	K1	CO5
10.	In a Bode plot, a Lag compensator is characterized by: (a) A high-frequency pole and a low-frequency zero (b) A low-frequency pole and a high-frequency zero (c) A high-frequency zero and a high-frequency pole (d) A low-frequency zero and a low-frequency pole	1	K1	CO5

PART - B (12 × 2 = 24 Marks)
Answer ALL Questions

		Marks	K-Level	CO
11.	List the advantages and disadvantages of open loop and closed loop system.	2	K1	CO1
12.	Infer the components of feedback control systems.	2	K2	CO1
13.	What are the basic components in a block diagram of a control system?	2	K1	CO1
14.	Mention the time domain specifications.	2	K2	CO2
15.	Define impulse signal.	2	K1	CO2

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create　　　**13962**

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16.	Give the relation between generalized and static error coefficients.	2	K2	CO2
17.	State Nyquist stability criterion.	2	K2	CO3
18.	What is root locus?	2	K1	CO3
19.	Define bandwidth.	2	K1	CO4
20.	What are the advantages of bode plot?	2	K1	CO4
21.	Draw the S-plane representation of lead compensator.	2	K2	CO5
22.	What is feedback compensation?	2	K1	CO5

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

23. a) Write the differential equations governing the mechanical rotational system. Obtain the transfer function of the system.　　11　K3　CO1
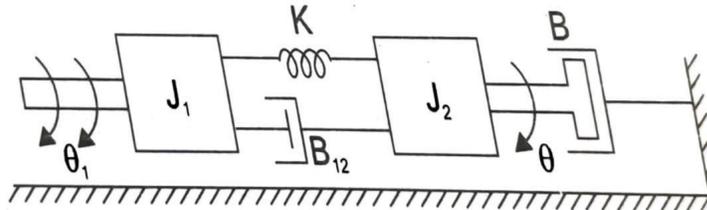
OR

b) Use Mason's gain formula for determining the overall T.F. of the system shown.　　11　K3　CO1
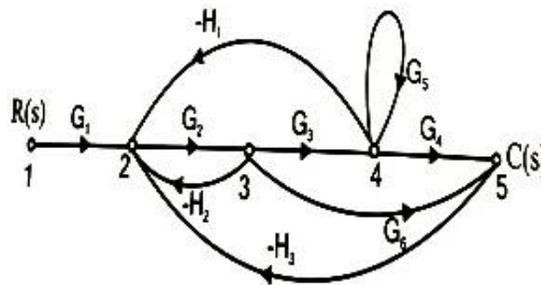
24. a) Develop the expression and draw the response of second order system for un-damped case with unit step input.　　11　K3　CO2

OR

b) Consider the unity feedback system with a closed loop transfer function $C(s)/R(s) = K(s+b) /s^2+as+b$. Determine open loop transfer function $G(s)$. Show that steady state error with unit ramp input is given by (a-k)/b.　　11　K3　CO2

25. a) Construct Routh array and determine the stability of the system whose characteristic equation is $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$. Also determine the number of roots lying on right half of s-plane, left half of s-plane and on imaginary axis.　　11　K3　CO3

OR

b) A unity feedback control system has on open loop transfer function,　　11　K3　CO3

$$(S) = \frac{K}{S(S^2 + 4S + 13)}$$

Sketch the root locus.

26. a) Sketch the bode plot for the unity fed back control system with transfer function,　　11　K3　CO4

$$G(S) = \frac{K}{S(S + 4)(S + 10)}$$

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create　　**13962**

b) Sketch the polar plot for the following transfer function and find gain cross over frequency, phase cross over frequency, gain margin and phase margin. 11 $K3$ $CO4$

$$G(S) = \frac{1}{S(1 + S)(1 + 2S)}$$

27. a) Derive the frequency response of lag-lead compensator. 11 $K3$ $CO5$

OR

b) Design a phase lead compensator for the system shown in fig. to satisfy the following specifications. (i) The phase margin of the system $\geq 45°$. (ii) Steady state error for a unit ramp input $\leq 1/15$. (iii) The gain cross over frequency of the system must be less than 7.5 rad/sec. 11 $K3$ $CO5$

28. a) i) Make use of type and order of a system and draw the typical polar plots of: 6 $K3$ $CO4$
    Type 0 Order 1
    Type 0 Order 2
    Type 1 Order 2
    Type 1 Order 3

   ii) Build the procedure for design of lag compensator using bode plot. 5 $K3$ $CO5$

OR

b) i) Derive the expressions of resonant peak with unit step input. 6 $K3$ $CO4$

   ii) Make use of Electrical network and realise the Lag compensator. 5 $K3$ $CO5$