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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S6 (PT) (S,FE) Examination December 2024 (2019 Scheme)

Course Code: EET302

Course Name: LINEAR CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

(Provide Ordinary, Polar and Semi Log graph sheet)

PART A

Answer all questions, each carries 3 marks. Marks

1	Compare open loop and closed loop systems with suitable examples.	(3)
2	Identify the transfer function of a unity gain compensator having pole at -4 and zero at -2 and identify whether it is a lag, lead or lag-lead compensator.	(3)
3	Derive the impulse response of second order undamped system.	(3)
4	Sketch the time response of poles a) $-2\pm j2$, b) $2\pm j2$ and c) $\pm j2$.	(3)
5	Write the magnitude and angle criterions for the root locus of negative feedback systems.	(3)
6	Design a P, PI and PID controller using Ziegler-Nichols method for the system with open loop transfer function $G(s) = \frac{2}{s(s+1)(S+2)}$.	(3)
7	Explain how Gain Margin and phase margin are determined from polar plot.	(3)
8	Sketch the frequency response of a system with transfer function $G(s) = \frac{1-sT}{1+sT}$.	(3)
9	State and explain Nyquist stability criterion.	(3)
10	Explain how Bandwidth is determined from Nichol's chart.	(3)

PART B

Answer one full question from each module, each carries 14 marks.

Module 1

11	a)	List the advantages and limitation of a system represented in transfer function.	(4)
	b)	Derive the transfer function of a field controlled DC servo motor and draw the block diagram.	(10)
		OR	
12	a)	With neat diagram, explain the working of Synchro transmitter.	(4)
	b)	Realise the lag-lead compensator using electrical network and derive the transfer function.	(10)

Module II

13 a) Derive the expression for peak overshoot, peak time, delay time and settling time of a second order under damped system subjected to unit step input. (9)

b) Obtain the unit step response of the following system characterized by the forward path gain $G(s) = \frac{16}{s(s+8)}$. Identify the nature of damping. (5)

OR

14 a) The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{50}{s(s+20)}$. Evaluate the static error constants of the system and steady state error for the input $r(t) = t^2 + 2t + 1$. (8)

b) A unity feedback control system is characterized by the open loop transfer function $G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$. Using Routh criterion, determine the range of K for stability. (6)

Module III

15 a) Sketch the root loci of a unity feedback control system whose open loop transfer function $G(s) = \frac{K}{s(s^2+6s+25)}$. Find the limiting value of K for stability. (10)

b) Compare the performance characteristics of PI and PD controllers. (4)

OR

16 a) Design a compensator for a system whose open loop transfer function is $G(s)H(s) = \frac{K}{s(s+4)(s+5)}$ to meet the following specifications (14)

(i) Damping ratio = 0.707 (ii) Kv $\geq$ 5 (iii) ω_n =2 rad/sec.

Module IV

17 a) Consider the open loop transfer function of a closed loop control system $G(s) = \frac{5}{s(s+4)(s+5)}$, sketch the polar plot, and determine gain margin and phase margin. (9)

b) Derive the expression for resonant frequency and resonant peak of a second order system. (5)

OR

18 a) For the given open loop transfer function $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$. Draw the bode plot and determine i) phase cross over frequency ii) gain cross over frequency iii) gain margin and iv) phase margin. Comment on the stability of the system. (14)

Module V

19 a) Draw the Nyquist plot for the system whose open loop transfer function is $G(s) = \frac{K}{s(s+2)(s+10)}$. Determine the range of K for which the system is stable (14)

OR

20 a) Design a lead compensator for a unity feedback control system with an open loop transfer function $G(s) = \frac{K}{s(s+1)(s+5)}$ to meet the following specifications (i) Velocity error constant $K_v \geq 50$ (ii) Phase margin $\geq 20^{\circ}$ (14)

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