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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree (S, FE) Examination January 2023 (2015 Scheme)

Course Code: EE303

Course Name: LINEAR CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1 The steady state response of a second order system to a unit step input settles to unity, and the transient response shows a peak overshoot of 16% and settling time (2% tolerance) of 4 sec. Obtain the transfer function of the system. (5)

2 Compute the settling time for the system with transfer function $\frac{2}{s+2}$. Also sketch the step response. (5)

3 Compute the angle of arrival of the root locus of characteristic equation of the system with open loop transfer function $G(s) = \frac{k(s^2+2s+5)}{s(s+1)}$ at -1+j2. (5)

4 Roughly sketch the root locus and show that the second order system with the following open loop transfer function is stable for all values of $K > 0$. (5)

$$G(s) = \frac{K}{s(s+1)}$$

5 Define gain margin and phase margin of a system. How are they related with the stability of the system? (5)

6 Make a rough sketch of the asymptotic bode plot and actual bode plot of the system with loop transfer $\frac{1}{s^2+s+1}$. (5)

7 Explain the phenomenon of transportation lag in control systems. What are its effect on the frequency response of the system. (5)

8 With the help of suitable diagrams, describe the effect of order and type number on the Polar plot for minimum phase systems. (5)

PART B

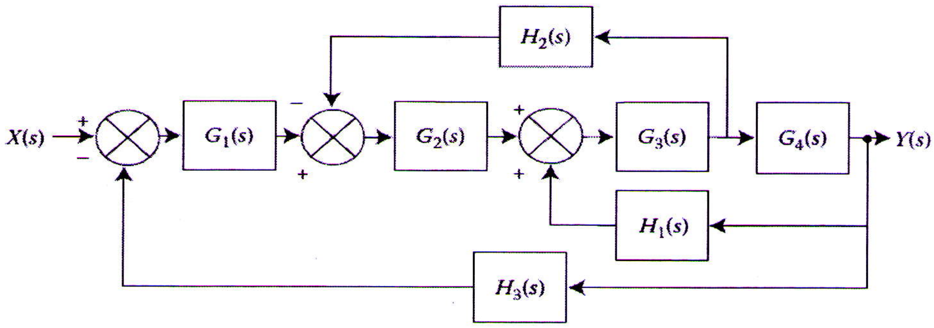
Answer any two full questions, each carries10 marks.

9 a) Obtain the transfer function of an armature controlled DC motor. Also draw the block diagram representation of the system. (6)

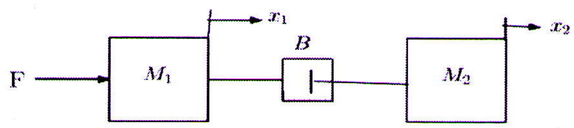
b) Derive the expression for peak time and maximum peak overshoot of a second order system for a unit step input. (4)

10 a) With the help of neat diagram, explain the working of AC Tachogenerator? (3)

b) Find the overall transfer function of the given system using block diagram reduction technique. (7)



11 a) Assuming x_2 as the output and F as the input derive the transfer function of system shown in figure below. Also sketch the analogous electrical circuit using force–current analogy. (5)



b) Open-loop transfer function of a unity-feedback control system is $\frac{k}{s(s+1)}$. (5)

What will be the ratio of gain for a damping ratio 0.1 to 0.9?

PART C

Answer any two full questions, each carries 10 marks.

12 a) Consider a system with open-loop transfer function $G)=\frac{K}{s(s+2)}$. What would be the steady state error to unit ramp input if K=2? What happens to the steady state error to unit parabolic input if K is increased? (6)

b) A unity feedback system has an open loop transfer function $\frac{K}{s(s+2)(s^2+6s+10)}$. Determine the number of closed loop poles on right half of the s plane if (i) K=10, and (ii) K=50. (4)

13 a) Determine the dynamic error constants to an input signal $r(t) = 1 + t$ for the system with open loop transfer function $G(s) = \frac{2}{s(s+4)}$. (4)

b) Find the breakaway point and gain at this point of the root locus of the system $G(s) = \frac{k}{s(s+2)(s+4)}$. (6)

14 Draw the root locus of the system with transfer function $\frac{(s+4)k}{s(s^2+8s+25)}$. Obtain the the gain k and the closed loop poles that gives a step response with peak overshoot of 50%. (10)

PART D

Answer any two full questions, each carries10 marks.

15 Sketch the polar plot for the unity feedback system with open-loop transfer function$G(s) = \frac{1}{s(1+s)^2}$ and determine the gain margin and phase margin. (10)

16 Apply Nyquist stability criterion and determine the stability and the number of poles of the system that lie to the right of the imaginary axis.$\frac{150}{(s-1)(s+10)^2}$ (10)

17 Sketch the bode plot of the system with open-loop transfer function $G(s) = \frac{500ke^{-0.1s}}{s(s+5)(s+20)}$ and determine the gain margin and phase margin when k=1. Compute the value of k for which system provides a phase margin of 45°. (10)

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