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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: EE303

Course Name: LINEAR CONTROL SYSTEMS (EE)

Max. Marks: 100 Duration: 3 Hours

Graph sheet and semi-log sheets will be supplied. Assume any missing data.

PART A

Answer all questions, each carries 5 marks.

1 Distinguish between open loop system and closed loop system. (5)

2 Obtain the transfer function of an AC tachogenerator. (5)

3 A unity feedback system has a open loop transfer function of $G(s) = \frac{10}{(s+1)(s+2)}$. Determine the steady state error for unit step input. (5)

4 What is angle criterion referred to root locus? (5)

5 Define gain margin and phase margin of a system. (5)

6 Determine the phase cross over frequency of a system with open loop transfer function $G(s) = \frac{1}{s(1+2s)(1+s)}$. (5)

7 Write a short note on Nichols chart. (5)

8 Explain the Nyquist stability criterion. (5)

PART B

Answer any two full questions, each carries 10 marks.

9 a) Obtain the force voltage analogy of a general mechanical translation system. (5)

b) Find the overall transfer function of the signal flow graph shown in Figure (1) using Mason's gain formula. (5)

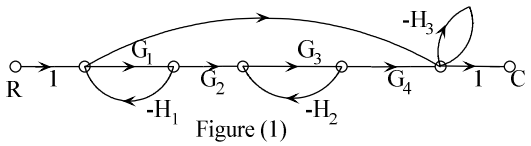

Figure (1)

10 a) Obtain the transfer function of an armature controlled DC motor. (5)

b) The forward path transfer function of a unity feedback control system is given by $G(s) = \frac{2}{s(s+3)}$. Obtain an expression for unit step response of the system. (5)

11 a) Explain the effect of time constant on the speed of time response of a control system. (4)

b) Obtain the electrical analogous of the mechanical system shown in Figure (2). Use force-voltage analogy. (6)

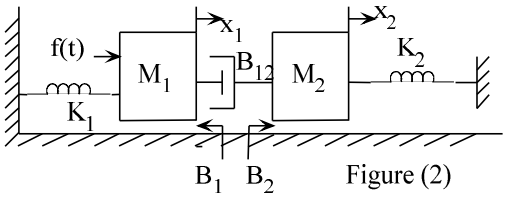

Figure (2)

PART C

Answer any two full questions, each carries 10 marks.

12 a) For a unity feedback control system with the open loop transfer function (5)

$$G(s) = \frac{10(s+5)}{s^2(s+1)}$$

Find the position, velocity and acceleration error coefficients.

b) Using Routh-Hurwitz criterion determine the relation between K and T so that unity feedback control system whose open loop transfer function given below is stable. (5)

$$G(s) = \frac{K}{s[s(s+20)+T]}$$

13 a) Explain the effect of addition of poles and zeros on the nature of root locus. (4)

b) Sketch the root locus for the open loop transfer function of a unity feedback system given below, (6)

$$G(s) = \frac{K}{s(s+1)(s+3)}$$

14 a) Determine the stability of the system whose overall transfer function is given below (5)

$$G(s) = \frac{2s+5}{s^5+1.5s^4+2s^3+4s^2+5s+10}$$

b) Explain the nature of time response of a second order system according to the location of roots of the characteristic equations. (5)

PART D

Answer any two full questions, each carries 10 marks.

15 a) Explain any three frequency domain specifications of a control system. (3)

b) The open loop transfer function of system is given by

$$G(s) = \frac{10}{s(0.4s+1)(0.1s+1)}$$

(7)

Draw the bode plot and obtain the gain and phase cross over frequencies.

16 a) Explain the steps involved in obtaining the polar plot. (3)

b) The open loop transfer function of a unity feedback system is given by (7)

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

Sketch the polar plot and determine the gain margin and phase margin.

17 a) Define the phase cross over frequency and gain cross over frequency of a system. (5)

b) Differentiate between minimum phase and non-minimum phase system with suitable examples. (5)

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