Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth semester B.Tech degree examinations (S) September 2020

Course Code: EE303

Course Name: LINEAR CONTROL SYSTEMS

Instructions: Graph sheets and semi log sheets are to be provided

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1 How do you analyse the performance of a mechanical system using electrical analogy? Explain with suitable example for Force- Voltage analogy. (5)

2 With relevant characteristics, explain the applications of synchro transmitter and receiver units? (5)

3 The input to a closed loop system with open loop transfer function $G(s) = \frac{K\,(s+3)}{s\,(s^2+3s+2)}$ consists of a step function and a ramp function as, r(t)= 2 u(t) + t. Determine the value of K such that the steady state error for the system is e_{ss}= 0.1. Determine the static error coefficients also. (5)

4 How do you determine the angle of departure of root locus branch from an open loop pole, using angle criterion. (5)

5 Derive and explain the dependence of damping factor on the resonant peak (M_r) of a second order system? (5)

6 Explain the significance of gain cross over frequency and phase cross over frequency in the system performance with suitable characteristics. (5)

7 State and explain Nyquist stability criterion? (5)

8 Obtain the polar plot and hence determine the value of K such that the system with open loop transfer function $G(s) = \frac{K}{s\,(s+1)(s+4)}$ is marginally stable? (5)

PART B

Answer any two full questions, each carries 10 marks.

9 a) Explain the Mason's gain formula for the derivation of transfer function with a suitable example. (5)

b) Analyse the effect of feedback block H(s) on the characteristic equation and pole-zero locations of the closed loop system having $G(s) = \frac{2}{(s^2 + 4s + 4)}$ with: i) $H(s) = \frac{1}{s}$; ii) H(s) = s (5)

10 a) Determine the unit step response for the system with transfer function $T(s) = \frac{1}{(s^2 + 4s + 5)}$. Also determine peak overshoot (M_p) and peak time (t_p). (6)

b) Explain the features and control applications of Tacho generators. (4)

11 a) Derive the transfer function of the Field controlled DC servo motor and hence explain the system characteristics? (6)

b) How does an automatic control system differ from an open loop system. Mention at least four general control system components required for the modification? (4)

PART C

Answer any two full questions, each carries 10 marks.

12 a) Test the stability of the unity negative feedback system with $G(s) = \frac{16}{s(s^5 + s^4 + 8s^3 + 6s^2 + 20s + 8)}$ using Routh's stability criterion. Hence identify the location of roots of the system. (7)

b) Explain how does the type of the system control the steady state error for a ramp input? (3)

13 Determine the stability of the closed loop system with $G(s)H(s) = \frac{K(s+1)}{(s^2 + 4s + 8)}$ using Root locus plot. Hence, determine the (10)

value of K such that the damping factor is 0.866.

14 a) Determine the value of M using Routh array, such that the system with characteristic equation $q(s) = s^4 + s^3 + M s^2 + 2s + 1$ is stable. (4)

b) With suitable illustrations explain how does addition of zeroes to the transfer function affect the root locus? (6)

PART D

Answer any two full questions, each carries 10 marks.

15 Determine the value of K such that the system with open loop transfer function $G(s)H(s) = \frac{K}{s(s+4)^2}$ is marginally stable, using Bode plot. (10)

16 a) Test the stability using Nyquist criterion, for the system with open loop transfer function $G(s)H(s) = \frac{2}{s(s+2)(s+4)}$ (7)

b) Compare between non minimum phase systems and minimum phase systems? (3)

17 a) With suitable characteristics explain the effects of Transportation lag (e^{-sT}) on Bode plot (5)

b) Explain the salient features and advantages of Nichols chart in Control system design. (5)

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