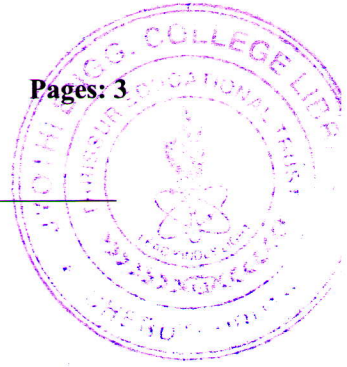


Reg No.: _____

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,
$r(t) = 2u(t) + t$. 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 (4)
characteristic equation $q(s) = s^4 + s^3 + Ms^2 + 2s + 1$ is stable.
- b) With suitable illustrations explain how does addition of zeroes to the transfer (6)
function affect the root locus?

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 (10)

$$G(s)H(s) = \frac{K}{s(s+4)^2} \text{ is marginally stable, using Bode plot.}$$

- 16 a) Test the stability using Nyquist criterion, for the system with open loop transfer (7)

$$\text{function } G(s)H(s) = \frac{2}{s(s+2)(s+4)}$$

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