Total Pages: 2

Reg No.:_____ Name:_____

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)

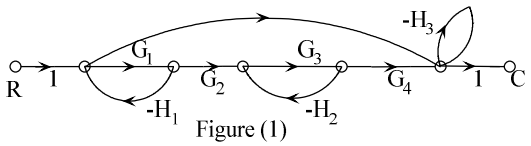

Figure (1)

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)

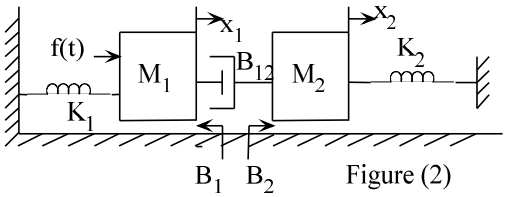

Figure (2)

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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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EE303

Course Name: LINEAR CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

(Graph sheets and semi-log graph sheets will be provided)

PART A

Answer all questions, each carries 5 marks Marks

1 Give a comparison between open loop and closed loop control systems. Give an example for each. (5)

2 Explain the working of an AC Tachogenerator with a schematic diagram. (5)

3 For a closed loop system with G(s) = 1/(s+5) and H(s) = 5, calculate the generalized error coefficients. (5)

4 What is a root locus? What are the information obtained from a root locus? (5)

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

6 Explain Gain margin and Phase margin. (5)

7 State and explain Nyquist stability criterion. (5)

8 Write notes on the following: (5)
i) Non-minimum phase systems ii) Transportation lag.

PART B

Answer any two full questions, each carries 10 marks

9 Derive the transfer function of an armature-controlled dc motor driving a load consisting of inertia and friction. Also draw the block diagram. (10)

10 a) Sketch the unit step response of an under damped second order system and mark various time domain specifications. (3)

b) Obtain the closed loop transfer function C(s)/R(s) using Mason's gain formula for a system whose signal flow graph is shown in Fig.1. (7)

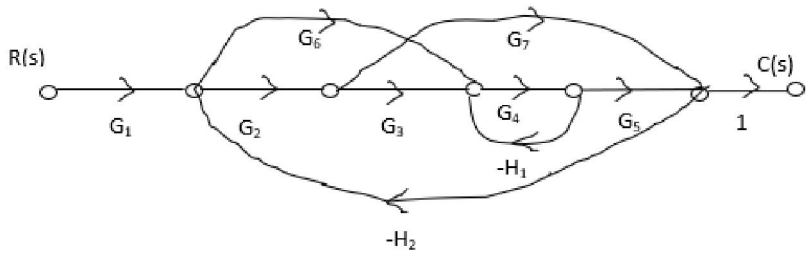

Fig.1

11 a) Derive an expression for peak time and settling time of an under damped second order system. (7)

b) A unity feedback control system is characterized by an open loop transfer function (3)

$G(s) = \frac{K}{s(s+10)}$ .Determine the gain K so that the system will have a damping ratio of 0.5

PART C

Answer any two full questions, each carries 10 marks

12 a) For the system shown in Fig.2, find the static error coefficients. Also find the steady state error for an input of 2u(t). (7)

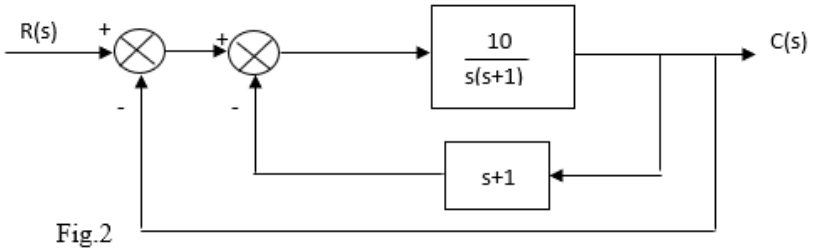

Fig.2

b) Explain the effect of adding a pole to a system on time response. (3)

13 Ascertain stability of the system whose characteristic equation is (10)

$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$

Also find the number of roots lying on the left half, right half and imaginary axis of the s-plane.

14 Sketch root locus for a system with (10)

$$G(s)H(s) = \frac{K}{s(S+2)(s^2+2s+2)}$$

Hence determine the range of K for the system stability.

PART D

Answer any two full questions, each carries 10 marks

15 Construct bode plot for the system whose open loop transfer function is (10)

$$G(s)H(s) = \frac{4}{s(1+0.5s)(1+0.08s)}$$

Determine the following:

i) Gain margin ii) Phase margin iii) Closed loop stability

16 Sketch the polar plot of a unity feedback control system having an open loop transfer function (10)

$$G(s) = \frac{K}{s(1+0.5s)(1+4s)}$$

Also determine the value of K so that:

i) Gain margin is 20dB ii)Phase margin is 30^0

17 Draw Nyquist plot for the system whose open loop transfer function is (10)

$$G(s)H(s) = \frac{K}{s(S+2)(s+10)}$$

Determine the range of K for which the closed loop system is stable

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

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 Derive the closed loop transfer function for a non-unity feedback system. (5)

2 Write short notes on Force- voltage and Force – current analogy? (5)

3 Check the stability of the system given by the characteristic equation (5)
$P(s) = s^5 + 2s^4 + 4s^3 + 8s^2 + 16s + 32$

4 What is magnitude and angle criterion? Determine whether the points (-4+j2) is on the root locus of a unity feedback system with forward transfer function $G(s) = \frac{K(s+2)}{s^2 + 4s + 13}$? (5)

5 Define any three frequency response specifications used for the design of control system? (5)

6 Explain how the stability of a system is analysed using Bode plot? (5)

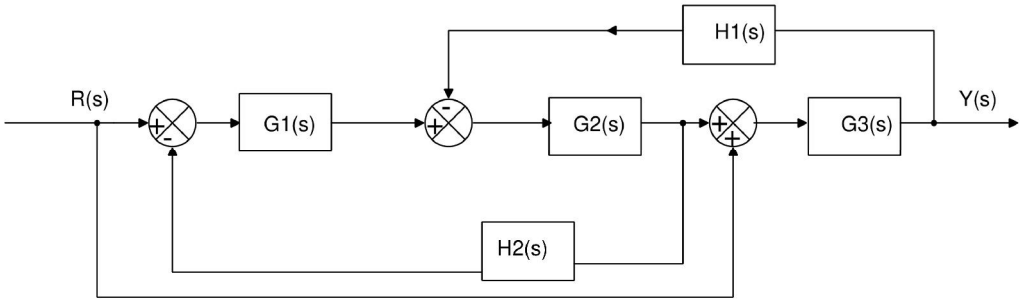
7 State and explain Nyquist stability criterion? (5)

8 Sketch the polar plot of type 1 second order system? (5)

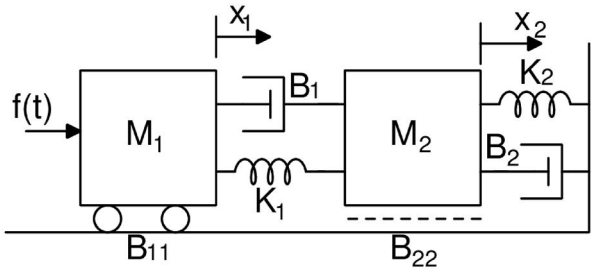
PART B

Answer any two full questions, each carries 10 marks.

9 a) Obtain the transfer function using block diagram reduction techniques. (5)



b) Derive the transfer function forthe mechanical system shown in figure. (5)

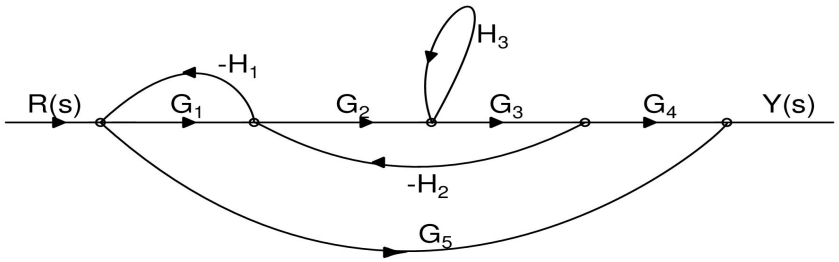


10 a) Derive an expression for the step response of a critically damped second order system? (4)

b) Determine the value of gain K and the natural frequency of oscillation ω_n for the unity feedback system with forward transfer function $G_p(s) = \frac{K}{s(s+10)}$, which results in a critically damped response when subjected to a unit step input. (6)

11 a) A unity feedback system is characterised by an open loop transfer function $G_p(s) = \frac{20}{s^2 + 5s + 5}$. Determine the transient response when subjected to a unit step input and sketch the response. Evaluate the maximum overshoot and the corresponding peak time of the system. (5)

b) For the signal flow graph shown below, determine the transfer function. (5)



PART C

Answer any two full questions, each carries 10 marks.

12 a) Consider a unity feedback system with an open loop transfer function $\frac{K}{s(s+20)}$. Determine the value K which would result in a steady state error of 0.05 for a unit ramp input. (5)

b) Using Routh-Hurwitz criterion determine the value of K for which the closed loop system transfer function $\frac{K}{s^3 + 20s^2 + 80s + K}$ is stable, marginally stable and unstable. (5)

13 Sketch the root locus of a negative feedback system whose open loop transfer function is given by $\frac{K(s+4)}{s(s+1)(s+2)}$. Determine the range of K for which the closed loop system is stable. (10)

14 a) Determine the dynamic error coefficients for a unity feedback system whose open loop transfer function is $\frac{20}{s(s+10)}$, when subjected to an input of $r(t) = 2 + t + 3t^{2.}$. Also compute the steady state error of the system. (6)

a) Discuss about the effect of addition of poles and zeros to the open-loop transfer (4)

function G(s) H(s) on the root locus.

PART D

Answer any twofull questions, each carries 10 marks.

15 a) The open-loop transfer function of a unity feedback system is $\frac{K}{s(0.5s+1)(0.04s+1)}$. Use asymptotic approach to plot the bode diagram and determine the value of K for a gain margin of 10.5 dB (10)

16 Draw the polar plot of open loop transfer function $\frac{6}{(s+1)(s+2)}$ and determine the phase margin and gain margin. (10)

17 a) What is transportation lag in control system? (4)

b) Draw the bode plot for the transfer function given by $\frac{5(s+2)}{s(s+10)}$ .Comment on the stability of the system (6)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: EE303

Course Name: LINEAR CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

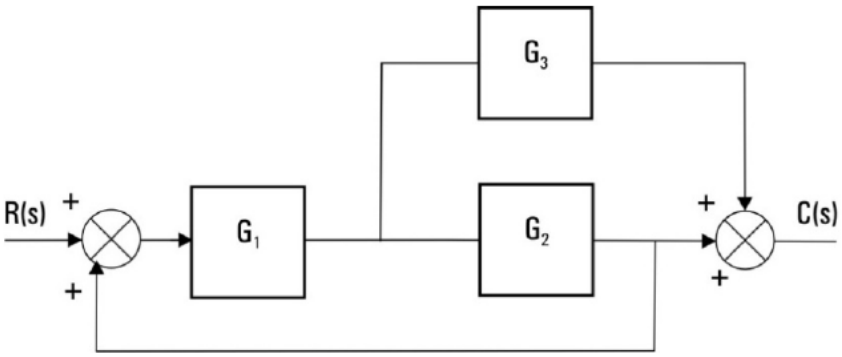
Answer all questions, each carries5 marks.

		Marks
1	Define transfer function and derive the transfer function of an RC network.	(5)
2	With the help of a neat diagram, explain the various time domain specifications.	(5)
3	The open loop transfer function of a unity feedback system is $\frac{9}{(s+1)}$ Using dynamic error coefficients, find an expression for an error if the input r (t) = 1 + 2t +1.5 t^2.	(5)
4	The open loop transfer function of a unity feedback system is $\frac{K}{s-4}$. Find the closed loop poles when k = 0, 1, 2, 3…..10 and mark it on the s- plane. Hence draw the root locus of the system.	(5)
5	Explain Gain margin and Phase margin with the help of bode plot. Mark gain crosses over frequency and phase cross over frequency.	(5)
6	With the help of suitable figure explain frequency domain specifications?	(5)
7	Give two examples of non-minimum phase transfer function. Explain why they are called non-minimum phase system?	(5)
8	Give a physical example of transportation lag. How can it be represented?	(5)

PART B

Answer any two full questions, each carries10 marks.

9 a) Consider the block diagram given in figure below. Draw the signal flow graph corresponding to the block diagram. Find the overall transfer function using Masons Gain Formula. (6)



b) Verify your answer using Block diagram reduction techniques. (4)

10 a) Explain the constructional features and principle of operation of a synchro? (5)

b) What are the advantages of stepper motor? List two applications of the stepper motor? (5)

11 a) Find the step response of a system with transfer function (6)

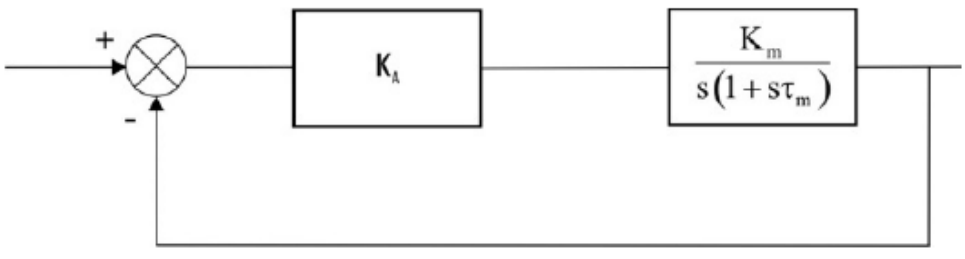
$\frac{4}{s(s+b)+4}$ If b=4 and b =5. Also find the effect of b on damping ratio?

b) With the help of a circuit diagram explain Force – Voltage and Force – Current analogy? (4)

PART C

Answer any two full questions, each carries10 marks.

12 a) Consider the system given in figure below. Given $K_m = 2$ and $T_m = 1$. If $K_A = 1$ find steady state error to step, ramp and acceleration input. (7)



b) What will happen to steady state errors if K_A is increased to 10? (3)

13 a) Explain the significance of angle and magnitude criterion in root locus? (5)

b) Consider a system with characteristic equation $a_0s^3 + a_1 s^2 + a_2s + a_3 =0$; given all coefficients are positive. Derive a sufficient condition for stability. (5)

14 a) The open loop transfer function of a unity feedback system is $\frac{10K}{s(s^2+2s+2)}$ Find the open loop poles? (2)

b) Draw the root locus. Find the range of values of K for which the system is stable. Find all the closed loop poles corresponding to a damping ratio of 0.7 (8)

PART D

Answer any two full questions, each carries 10 marks.

15 a) Sketch the bode plot and find the gain crossover frequency for given $G(s)H(s) = \frac{10}{s(s+5)}$ (6)

b) Given $G(s) = \frac{1}{s^2(s+2)}$ (4)

Find $< G(j\omega)$ at $\omega = 0$

16 The open loop transfer function of a unity feedback system is $\frac{10}{s(s+2)(s+5)}$ Draw the Bode plot and find Gain margin and phase margin? (6)

(4)

17 The open loop transfer function of a unity feedback system is $\frac{2K}{s(s+1)(s+2)}$ Investigate the stability of the system if K =1 using Nyquist stability criteria. Find the range of values of K for which the system is stable (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DEC 2019

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 Explain Mason's gain formula? (5)

2 Obtain the unit step response of first order system? (5)

3 A unity feedback system has an open loop transfer function $\frac{20(s+5)}{s^2(s+0.1)(s+3)}$. (5)

Determine steady state error for unit parabolic input?

4 Explain the effect of adding poles and zeros on root locus? (5)

5 Sketch the bode plot for given $G(s)H(s)=\frac{10}{s(s+2)}$ without using semi log sheet? (5)

6 Explain about frequency domain specifications? (5)

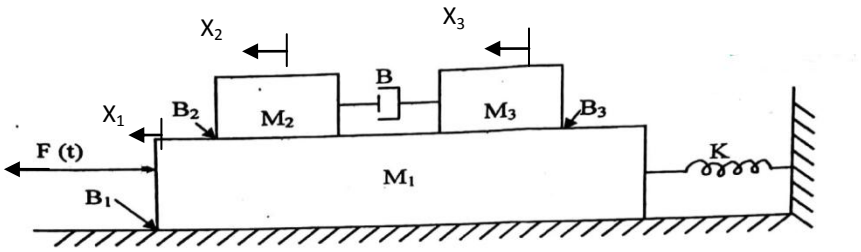
7 Draw the polar plot of type 0 second order system? (5)

8 Explain transportation lag and non-minimum phase systems? (5)

PART B

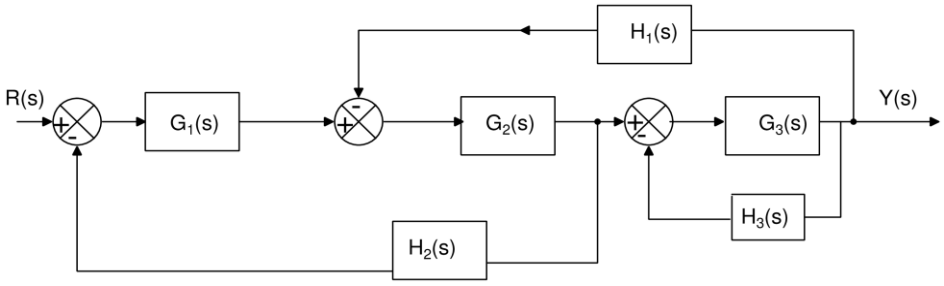
Answer any two full questions, each carries10 marks.

9 a) Write the differential equations governing the mechanical system and hence draw the electrical analogous circuit using F-V analogy and F-I analogy (6)



b) Derive the transfer function of an armature controlled dc motor with block diagram? (4)

10 a) Obtain the overall transfer function using block reduction techniques? (6)



b) What are the standard test signals used for time domain analysis? (4)

11 a) Derive the expression for maximum peak overshoot, rise time and peak time of a second order system for a step input? (6)

b) Explain the construction and working principle of a synchro - transmitter? (4)

PART C

Answer any two full questions, each carries10 marks.

12 a) Evaluate the static error coefficients and steady state error for a unity feedback system having a forward path transfer function $\frac{50}{s(s+10)}$ for the input $r(t)=1+2t+t^2$ (6)

b) Explain important rules for root locus? (4)

13 Sketch the root locus for a unity feedback system with open loop transfer function $\frac{k}{s(s+2)(s+3)}$ and find the range of k for the system to exhibit sustained oscillations? (10)

14 a) Find the location of roots of the characteristic equation (5)

$s^6+4s^5+3s^4-16s^2-64s-48=0$ in LHS, RHS and imaginary axis.

b) Determine (i) type (ii)error constants (iii) steady state error for the parabolic input if the open loop transfer function is $\frac{12(s+2)}{s^2(s^2+7s+12)}$ (5)

PART D

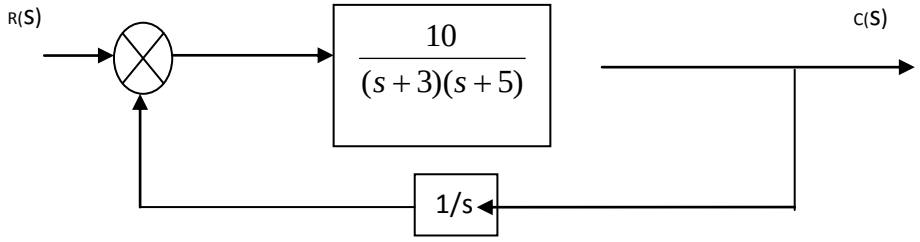
Answer any two full questions, each carries 10 marks.

15 a) Sketch the polar plot for the following transfer function $\frac{10}{s(1+s)(1+0.05s)}$. (6)

b) Explain gain margin and phase margin of a system using Bode plot? (4)

16 Find the value of open loop gain k for G(s)H(s)= $\frac{k}{s(1+0.1s)(1+s)}$ so that the system has a) phase margin of 60^o b) gain margin 15 dB using Bode plot (10)

17 For the system shown in figure determine the stability using Nyquist plot. (10)



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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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