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)

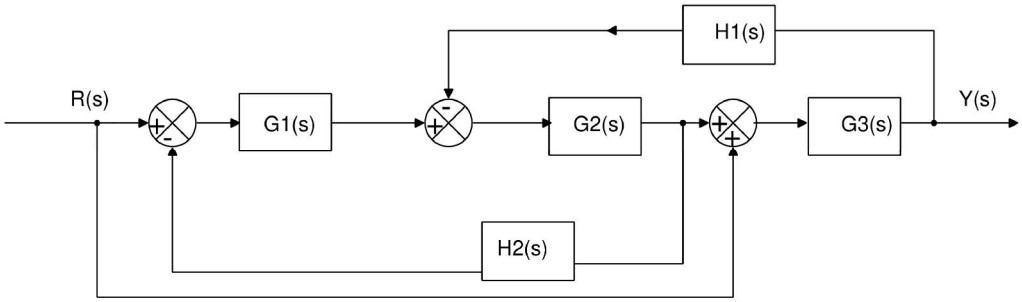
7 State and explain Nyquist stability criterion? (5)

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

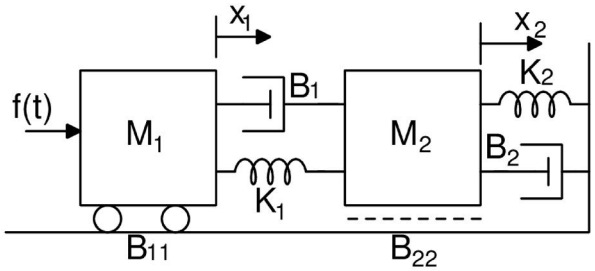
PART B

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)

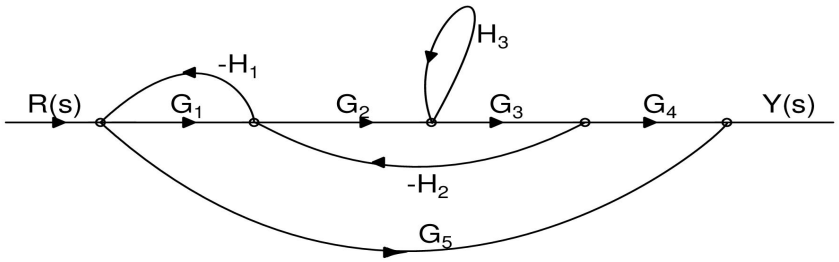


10 a) Derive an expression for the step response of a critically damped second order system? (4)

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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