

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.

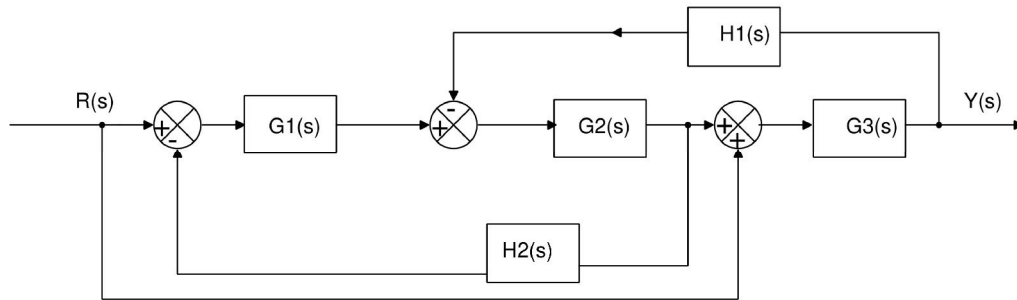
Marks

- 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 (5)
 $G(s) = \frac{K(s+2)}{s^2 + 4s + 13}$?
- 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)

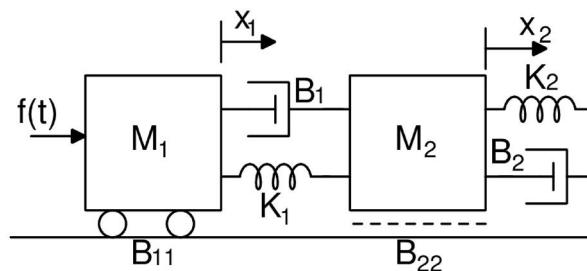
PART B

Answer any two full questions, each carries 10 marks.

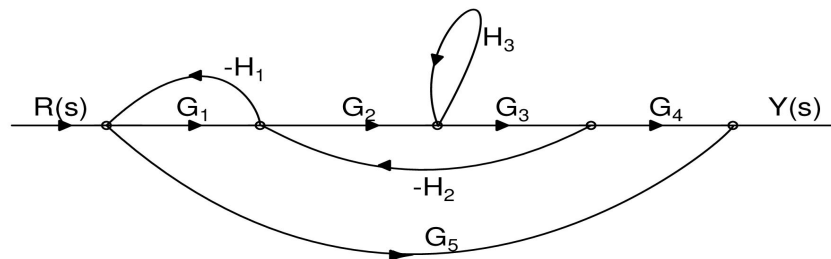
- 9 a) Obtain the transfer function using block diagram reduction techniques. (5)



- b) Derive the transfer function for the 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)
