Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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

Course Code: EC409

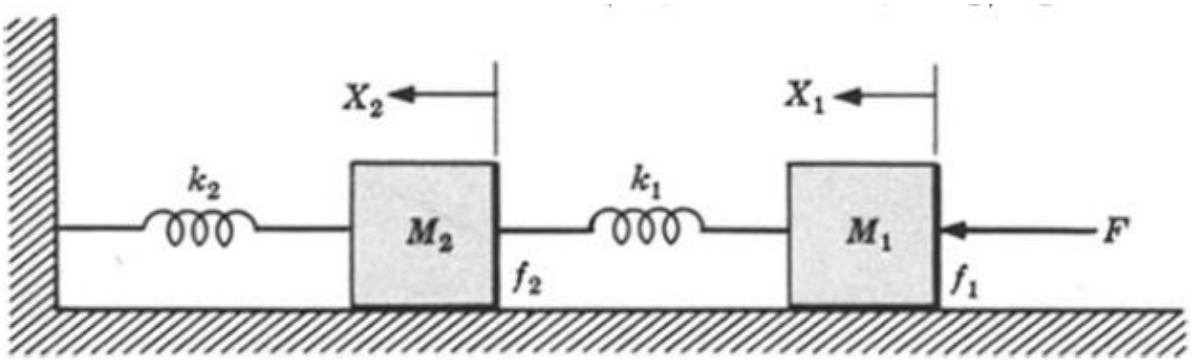
Course Name: CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

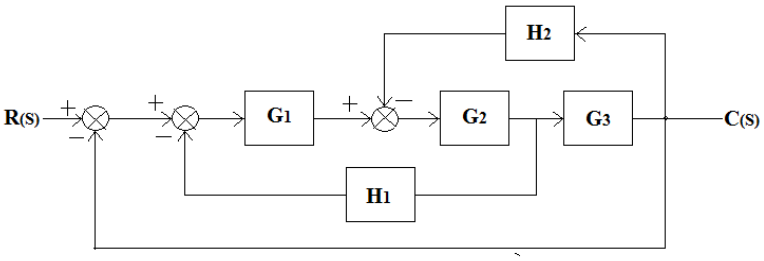
PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Write the differential equations governing the mechanical system. (5)



b) Obtain the transfer function of the system shown in fig.(3) using block diagram reduction techniques (10)



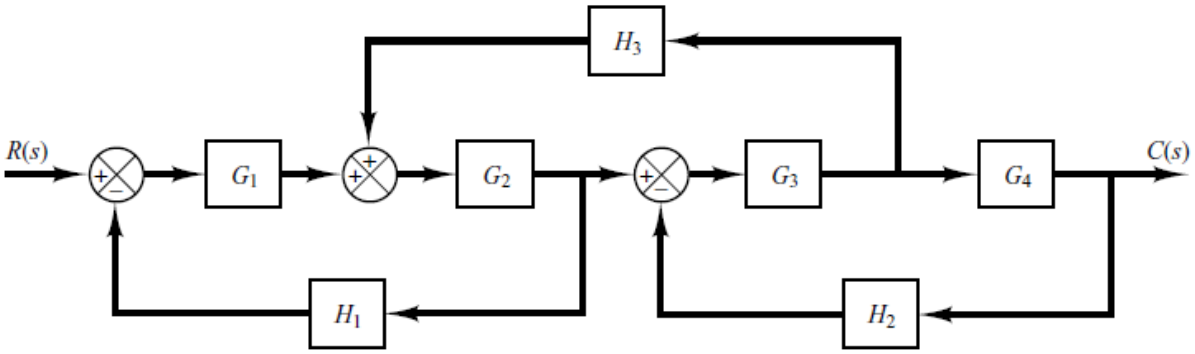
2 a) The forward path transfer function of a unity feedback control system is given by $(s) = \frac{4}{s(s+5)}$ (5)

.Obtain the response of the system to unit step input.

b) A unity feedback control system has an open loop transfer function $G(S) = \frac{10}{s(S+2)}$.Find the rise time and peak time for a step input of 12 units. (5)

c) Obtain the time response of a first order system to ramp input and find the steady state error. (5)

3 a) Find the transfer function of the given system using block reduction technique. Verify the result using Mason's gain equation (10)



b) Derive an expression for the maximum percentage overshoot of a second order under damped system. (5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) What are frequency domain specifications? Define any three. (5)

b) A unity feedback control system has an open loop transfer function (10)

G(s)=K(s+9)/ s(s+3)(s+5).Sketch the root locus.

5 a) What are Bode plots ? What are its advantages. How is stability determined from Bode plots. (5)

b) Plot the Bode diagram for the following transfer function (10)

$$G(S) = KS^2 / (1+0.2S)(1+0.02S)$$

Determine the value of K for a gain cross over frequency of 20 rad/sec.

6 a) Draw the Nyquist plot for the system whose open loop transfer function is (8)

$G(s)H(s) = \frac{K}{s(s+2)(s+10)}$. Determine the range of K for which the closed loop system is stable.

b) The open loop transfer function of certain unity feedback control system is given by (7)

$G(s) = \frac{K}{s(s+4)(s+80)}$. It is desired to have the phase margin to be at least 33° and the velocity error constant K_v = 30 per sec. Design a phase lag series compensator.

PART C

Answer any two full questions, each carries 20 marks.

7 a) Construct the state model for the system described by (10)

$$\ddot{y} + 7\dot{y} + 5y + 6\int_0^t y\,.dt = \dot{u} + 3u + 2\int_0^t u\,dt$$

b) The transfer function of a control system is given by $\frac{Y(s)}{U(s)} = \frac{s+2}{s^3+9s^2+26s+24}$ .Check for controllability and observability. (10)

8 a) Check for stability of the system using Jury's Test (10)

$Q(z) = z^3 - 1.8z^2 + 1.05z - 0.20 = 0$

b) Derive Discrete Time Approximation of a Continuous Time State Space Model for the state equations (10)

9 a) Obtain the state model for the given transfer function (10)

$$\frac{Y(s)}{U(s)} = \frac{1}{s^2 + s + 1}$$

b) Determine the z-domain transfer function for the following s-domain transfer functions (10)

(a) H(s)=$\frac{a}{(s+a)^2}$ (b) H(s)=$\frac{a}{s^2-a^2}$

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