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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: EC409

Course Name: CONTROL SYSTEMS

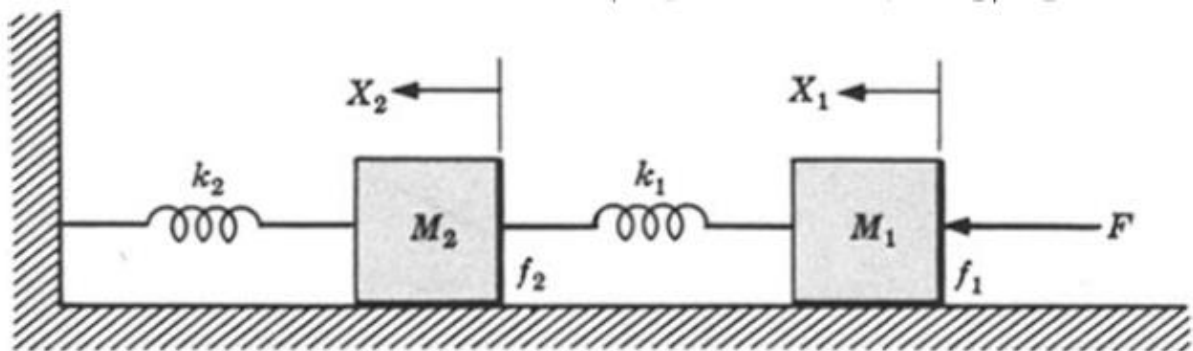
Max. Marks: 100

Duration: 3 Hours

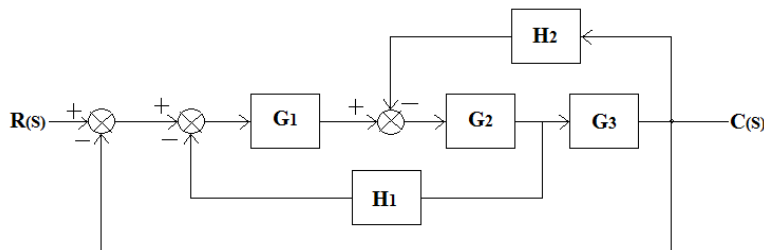
PART A*Answer any two full questions, each carries 15 marks.*

Marks

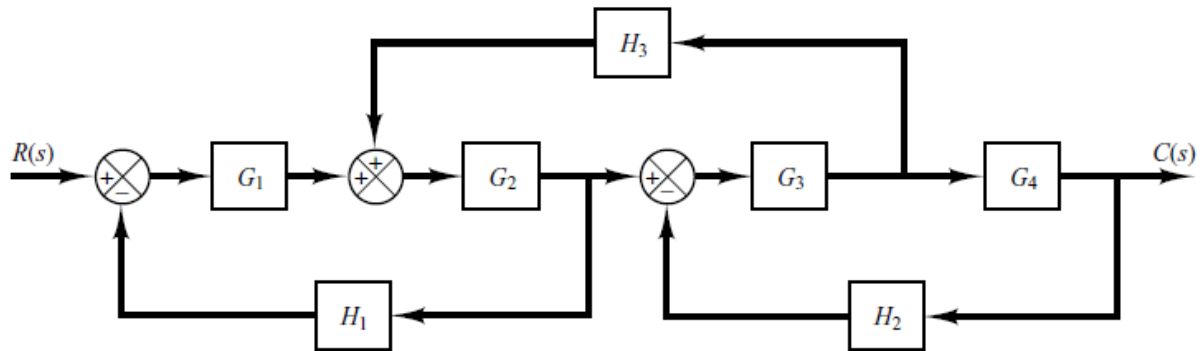
- 1 a) Write the differential equations governing the mechanical system. (5)



- 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 $G(s) = \frac{4}{s(s+5)}$ (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 (5)
 rise time and peak time for a step input of 12 units.
- 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 (10)
 result using Mason's gain equation



- 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)
- $$G(s) = \frac{K(s+9)}{s(s+3)(s+5)}$$
- Sketch the root locus. (5)
- 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)

$$G(S) = \frac{KS^2}{(1+0.2S)(1+0.02S)}$$

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)

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

- 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 (10)
for controllability and observability.

- 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

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

(10)

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

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