

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC409

Course Name: CONTROL SYSTEMS

Max. Marks: 100

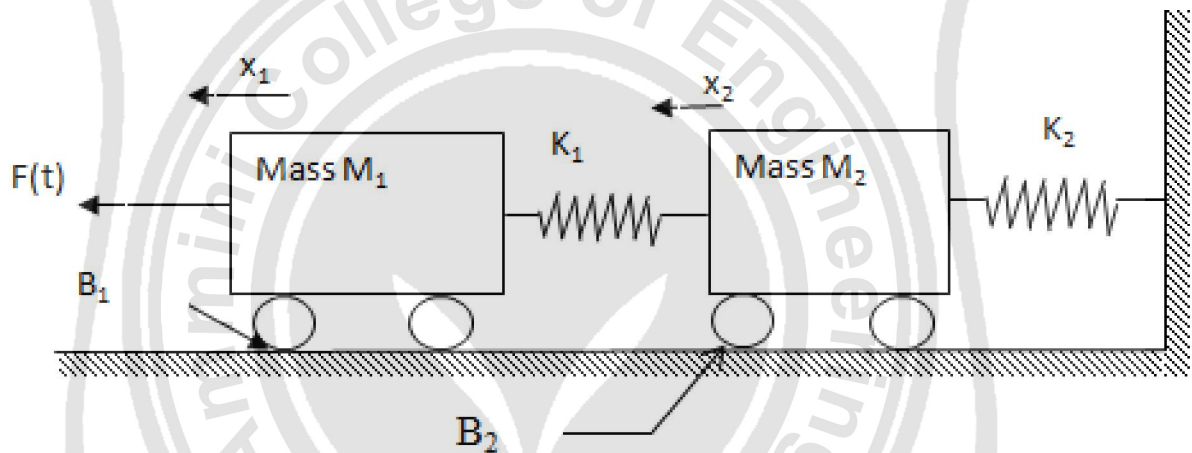
Duration: 3 Hours

PART A

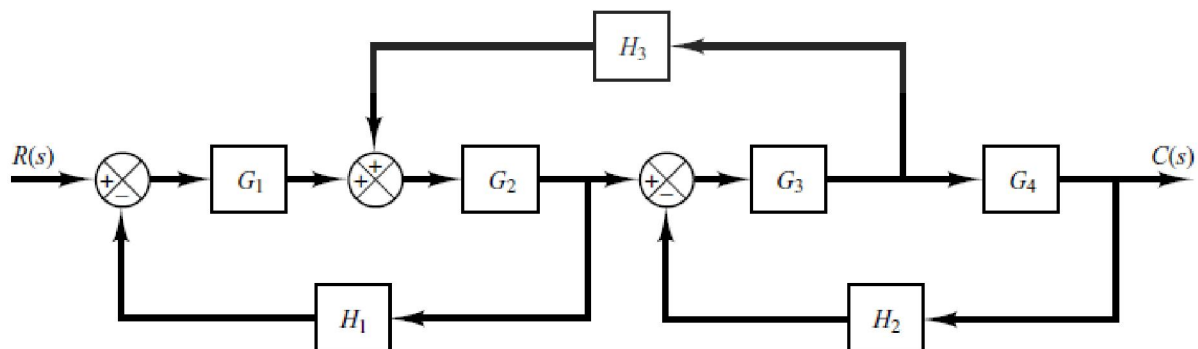
Answer any two full questions, each carries 15 marks.

- 1 a) Draw the signal flow graph for the following sets of algebraic equations. (5)
- $$x_1 = ax_0 + bx_1 + cx_2, \quad x_2 = dx_1 + ex_3, \quad x_3 = fx_0 + gx_2, \quad x_4 = hx_3$$

- b) Find the transfer function $\frac{X_2(S)}{F(S)}$. Also draw the force voltage analogy of the given system (10)



- 2 a) Explain how the overall transfer function of a system can be found by using Mason's gain formula. (5)
- b) Derive an expression for peak time of a second order system. (5)
- c) Derive an expression for time response of a second order under damped system to step input. (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) Determine the step, ramp and parabolic error constants for the unity feedback control system. (5)
- $$G(S) = \frac{10(S+2)}{(S+1)S^2}$$

PART B

Answer any two full questions, each carries 15 marks.

- 4 a) Using Routh Hurwitz criterion, determine the number of roots in the right half of S-plane (5)
- $$S^4 + 2S^3 + 10S^2 + 20S + 5 = 0$$
- b) Sketch the root locus for $G(s)H(s) = \frac{K}{s(s+6)(s^2+4s+13)}$ (10)
- 5 a) Compare PI, PD and PID controllers. (5)
- b) Plot the Bode diagram for the following transfer function and find the Gain margin and Phase margin. (10)
- $$G(S) = 10 / S(1+0.4S)(1+0.1S)$$
- 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) Describe the design procedure of a lead compensator. (7)

PART C

Answer any two full questions, each carries 20 marks.

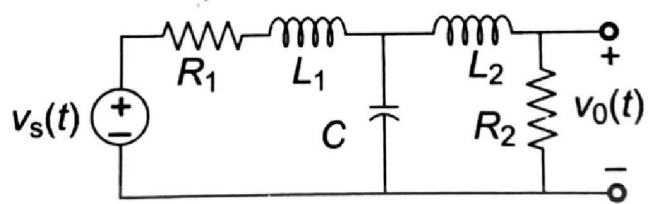
- 7 a) A dynamic system is represented by the state equation. (5)
- $$X = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} r$$
- Check whether the system is completely controllable.
- b) What is transfer matrix of a control system? Derive the equation for transfer matrix. (7)
- c) Obtain the state model for the given transfer function (8)

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

- 8 a) State initial and final value theorem for Z transform (5)
- b) Derive the expression for pulse transfer function of a zero order hold system (7)

c) Determine the state transition matrix of $A = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix}$ (8)

9 a) Represent the electrical network shown in fig a in state model in physical variable form (10)



b) For the sampled data control system shown in Fig, find the response to unit step input where (10)

