Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh semester B.Tech examinations (S), September 2020

Course Code: EC409

Course Name: CONTROL SYSTEMS

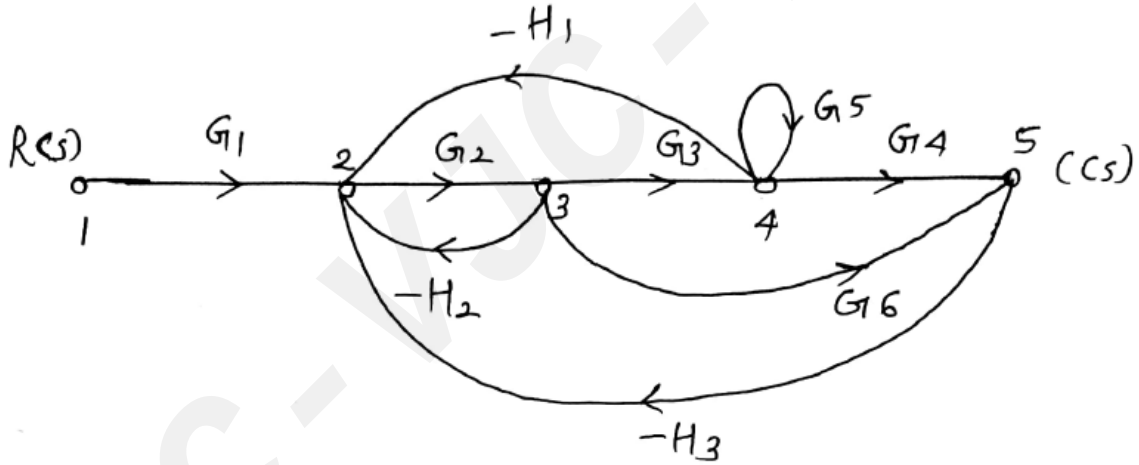
Max. Marks: 100 Duration: 3 Hours

PART A

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

1 a) Compare open loop and closed loop system with suitable examples. (5)

b) Find the transfer function using Mason's gain equation (10)

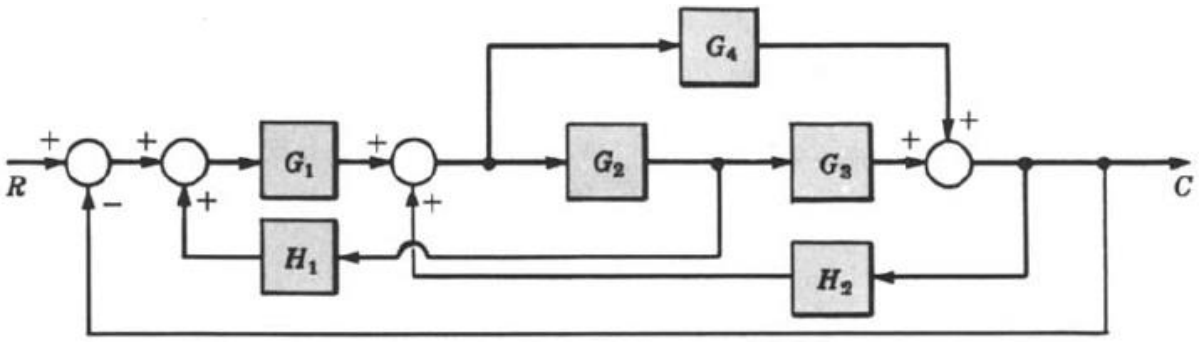


2 a) Determine the rise time, peak time, settling time and peak overshoot of a second order control system subjected to a unit step input. The damping ratio = 0.5 and undamped natural frequency $w_n = 6\ rad/sec.$ (5)

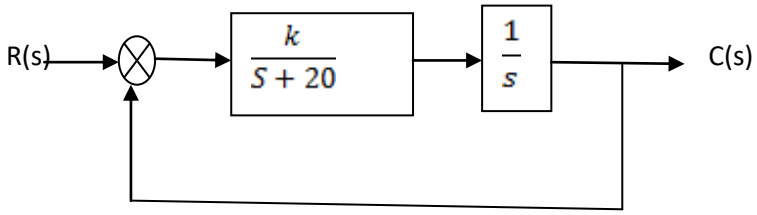
b) Derive an expression for rise time of a second order system. (5)

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 (10)



b) The block diagram of a unity feedback (negative) system is shown in figure. Determine the steady state error for unit ramp input when K=400. Also determine the value of K for which the steady state error to unit ramp will be 0.02 (5)



PART B

Answer any two full questions, each carries 15 marks.

4 a) Comment on the stability of the system whose characteristic equation is given by $s^5+2s^4+3s^3+6s^2+2s+1=0$. (5)

b) A unity feedback control system has an open loop transfer function $G(s)=K(s+9)/\ s(s+3)(s+5)$.Sketch the root locus. (10)

5 a) Compare PI,PD and PID controllers. (5)

b) Sketch the bode plot for the following transfer function and determine phase margin and gain margin. $G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$. (10)

6 a) Draw the Nyquist plot for the system whose open loop transfer function is $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$. Determine the range of K for which the closed loop system is stable. (8)

b) Describe the design procedure of a lag compensator. (7)

PART C

Answer any two full questions, each carries 20 marks.

7 a) A linear system representation in state space is given as (5)

$$X = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} r$$

$$y = [2 \quad 2 \quad 2]$$

Apply Kalman's test to find whether the system is completely observable.

b) A system is represented by the differential equation y''+3y'+2y = r''+2r'+2r.Obtain a state model in controllable canonical form. Draw the state diagram. (7)

c) Obtain the state model for the given transfer function (8)

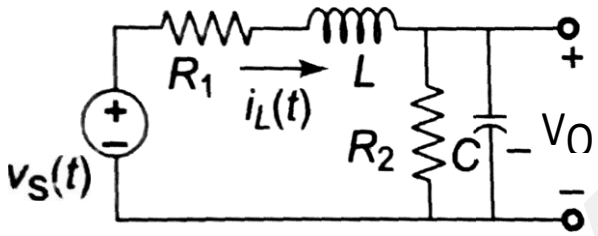
$$\frac{Y(s)}{U(s)} = \frac{1}{s^2+s+1}$$

8 a) Explain the procedure of jury test. (5)

b) The input-output relation of a sampled data system is described by the equation $c(k+2)+3c(k+1)+4c(k)=r(k+1)-r(k)$. Determine the z-transfer function. (7)

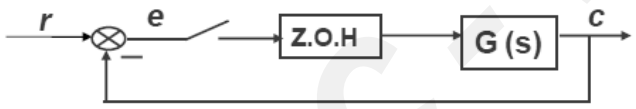
c) Determine the state transition matrix of A=$\begin{bmatrix}0 & 1\\ 0 & -2\end{bmatrix}$ (8)

9 a) An electrical network is shown in fig. a Select asset of proper state variables and write down a state equation, in physical-variable form, to represent the system (10)



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

G(s)=$\frac{1}{(s+1)}$



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