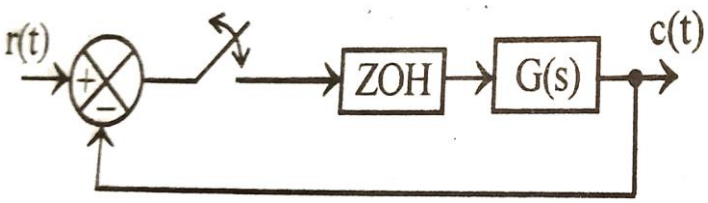
12 a) Define controllability and observability of a system and check whether the system $\frac{Y(s)}{U(s)} = \frac{1}{(s+1)(s+2)}$ is controllable or not. (6)

b) Check the stability of the sampled data control system shown below (4)

$z^3-0.2z^2-0.25z+0.05=0$

13 Determine the pulse transfer function of the discrete time control system shown in figure for a sampling time of T=1 sec. Also find the response to unit step input. The transfer function of the system is G(s) = 1/(s+1). (10)



14 a) Derive the state model of an R-L-C series circuit (3)

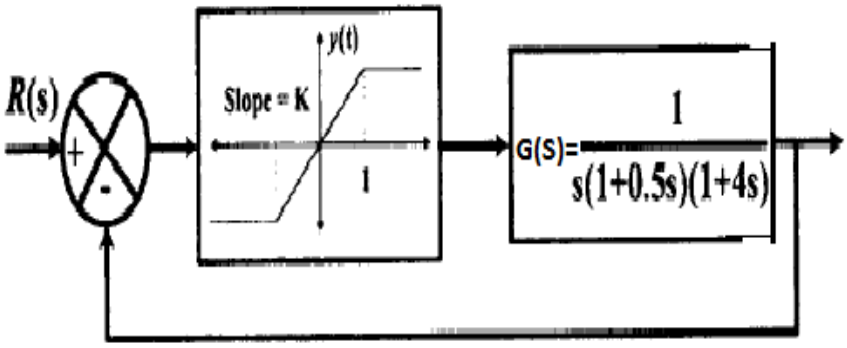
b) Consider a linear system described by the transfer function Y(s)/U(s) =10/[S(S+1)(S+2)]. Design a feedback controller with a state feedback so that the closed loop poles are placed at -2, -1±j1. (7)

PART D

Answer any two full questions, each carries 10 marks.

15 Derive the Describing function of saturation with Dead-zone nonlinearity. (10)

16 Consider a unity feedback system shown in figure having a saturating amplifier with a gain K. Determine the maximum value of K for the system to be stable. What would be the frequency and nature of limit cycle for a gain of K=2.5? (10)



17 A linear second order system is described by the equation (10)

$\ddot{e} + 2\delta\omega_n\dot{e} + \omega_n^2 e=0$

Where $\delta = 0.15$, $\omega_n = 1$rad/sec, e(0)=1.5, and $\dot{e}(0) = 0$

Determine the singular point and state the stability by constructing the phase trajectory using the method of isoclines.

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