n – VIII /Paper / Subject Code: 53201 / Digital Control System /Dec – 2019

SGGS - INST

Total Marks : 80 (3 Hours) Q.P.Code:

Note: (1) **Q1 is compulsory**

(2) Attempt **any three** from the remaining

(3) Assume suitable data wherever necessary.

Q1. Solve any four **20**

a. Explain the mapping between s-plane and z-plane.

b. Explain how Mason's Gain Formula is applied in digital control systems.

c. Define State Transition Matrix. Explain its properties.

d. Explain Controllabilty and Observability with their standard forms.

e. What are different forms of control structures?

f. Explain sampler as an impulse modulator.

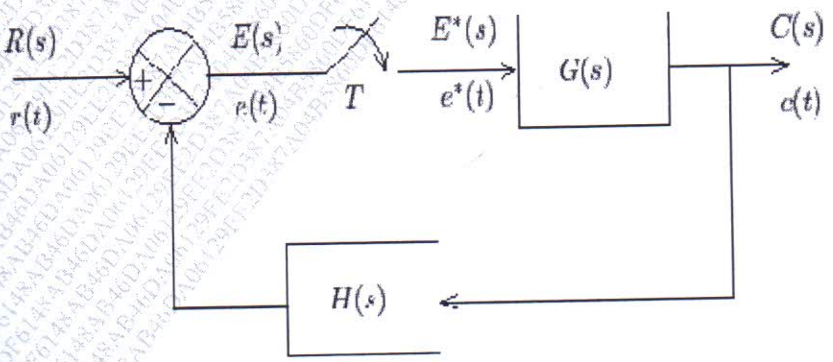
Q2. a Derive the transfer function for ZOH. **10**

Q2. b Obtain companion I and companion II forms for the following system **10**

$$G(Z) = \frac{2Z^2 + Z + 5}{Z^3 - 0.7Z^2 + 3Z + 4}$$

Q3.a Determine the discrete time transfer function G(z) given that $G(s) = \frac{4}{s+8}$ Which is in cascade with Zero Order Hold device. Sampling period given is 0.50 sec. **10**

Q3.b. Evaluate the Pulse Transfer Function for the following system using Sampled Flow Graph technique. **10**



Q4.a. Derive the expressions for steady state error constants for step, ramp and parabolic inputs for a digital control system **10**

Q4.b. A PID controller is described by the following relation between input and output *e(t) and u(t)* respectively. **10**

$$u(t) = k_P\left(e(t) + \frac{1}{T_i}\int_0^t e(t)dt + T_D \frac{de(t)}{dt} \right)$$

Using the trapezoidal rule for integration and backward-difference approximation for the derivative, obtain difference equation model of the PID algorithm. Also obtain the transfer function from u*(t)* to *e(t)*.

Q5.a. Determine the stability of following function using Jury's criterion **10**

$$F(Z) = Z^3 - Z^2 - 0.19Z + 0.28$$

Q5.b. Design a state feedback controller to place the closed loop poles at locations 0.5, 0.6 and 0.7 for the following system **10**

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(k)$$

Q6.a. Explain Aryabhatta's Identity Algorithm in detail **10**

Q6.b. Verify whether feedback control system given in figure, in which controller is designed with unstable pole- zero cancellation is internally stable? **10**