BE/sem VIII / inst / Digital Control Systems

25.11.16 **Q.P. Code : 722203**

(3 Hours) **Total Marks : 80**

Note: (1) **Q. No.1** is **compulsory**.

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

(3) Assume suitable **data** wherever **necessary**.

1. Answer the following. (**ANY FOUR**) **20**

a) Explain the significance of unit circle in Z domain analysis of digital control system.

b) State and explain Kalman's principle of duality.

c) Define controllability and observability and also give their formulaes.

d) Define state transition matrix and write the properties of state transition matrix.

e) Explain how the Mason's gain formula is applied to digital control system.

f) 'Internal stability ensures controller realizability', Justify.

2. a) Find G(z) for $G(s) = \frac{8}{s+4}$ in cascade with zero order sample and hold. The sampling period is 0.25 seconds. **10**

b) What do you mean by pole placement? Derive Ackerman's formula for finding feedback gain matrix. **10**

3.a) What do you understand by dead beat response of an observer? Design a state observer to obtain dead beat response for the system given below:- **10**

$$x(k+1) = \begin{bmatrix} 0.1 & 0 \\ 0 & 0.15 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(k)$$

$$y(k) = [0 \;\; 1]\, x(k)$$

b) Represent the following systems in controllable and diagonal canonical forms along with its block diagram realization. **10**

$$G(Z) = \frac{4z^3 - 12z^2 + 13z - 7}{z^3 - 4z^2 + 5z - 2}$$

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4. a) A discrete time system has a state equation given by: **10**

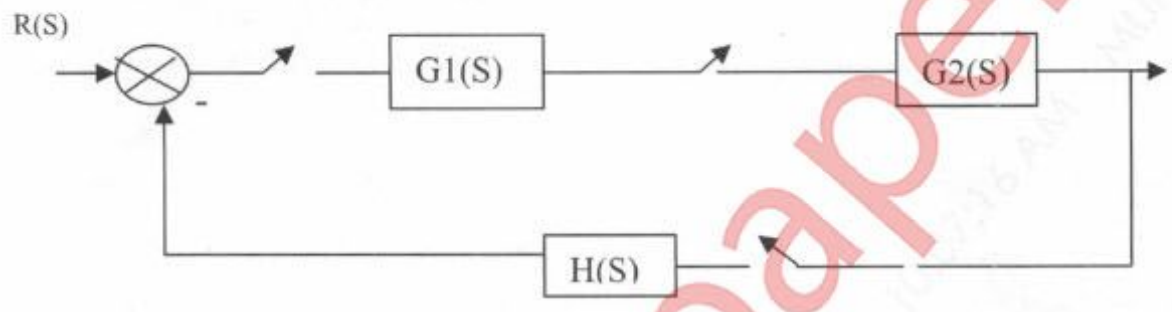
$$x(k+1) = \begin{bmatrix} 0 & 1 \\ -3 & 4 \end{bmatrix} x(k)$$

use Caley Hmilton theorem to obtain state transition matrix. Verify the result with Z transform approach.

b) Compare following methods of discretization: **10**

i) impulse invariance
ii) step invariance
iii) Finite difference approximation of derivatives
iv) Bilinear Transformation.

5. a) The block diagram of the system is shown below, calculate static error constants and steady state error for unit step, ramp and acceleration inputs. **10**



b) Check the stability of the system using Jury's stability test. **05**

$$z^3 - 1.8z^2 + 1.05z - 0.2 = 0$$

c) Explain the working of zero order hold and derive it's trasfer function. **05**

6. a) Write short note on bumpless PID controller with $T_c=S_c$. Determine discrete time PID controller if we have following continuous time PID settings: K=2, τ_d=2.5 s, τ_i= 40 s, τ_s=1 s. **10**

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