

- N.B.: 1) Question No. 1 is compulsory.
2) Attempt any three questions from the remaining questions.
3) Figures to the right indicate full marks.
4) Assume suitable data if necessary.



1. Answer the following. (ANY FOUR) 20
- Explain the bilinear transformation maps the left half of the s plane into unit circle in z plane.
 - Define position, velocity and acceleration error constants for a digital control system.
 - Explain the effect of sampling on stability and steady state performance of digital control system.
 - State and explain Kalman's principle of duality.
 - Explain Aryabhata's identity.
2. a) Obtain the pulse transfer function for the following system. 10

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -0.12 & -0.01 & 1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} v(k)$$

$$y(k) = [1 \quad 0 \quad 0]$$

- b) A discrete time regulator system has a plant- 10

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ -4 & -2 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(k)$$

Design a state feedback controller which will place the closed loop poles at $-0.5 \pm j0.5$.

3. a) A discrete time system has a state equation given by- 10

$$x(k+1) = \begin{bmatrix} 0 & 1 \\ -10 & -7 \end{bmatrix} x(k)$$

use Cayley Hamilton theorem to obtain state transition matrix. Verify the result with z transform approach.

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

$$G(Z) = \frac{Z^{-2} + 0.5Z^{-3}}{1 - Z^{-1} + 0.01Z^{-2} + 0.12Z^{-3}}$$

$$G(Z) = \frac{1.65(Z + 0.1)}{Z^3 + 0.7Z^2 + 0.11Z + 0.005}$$

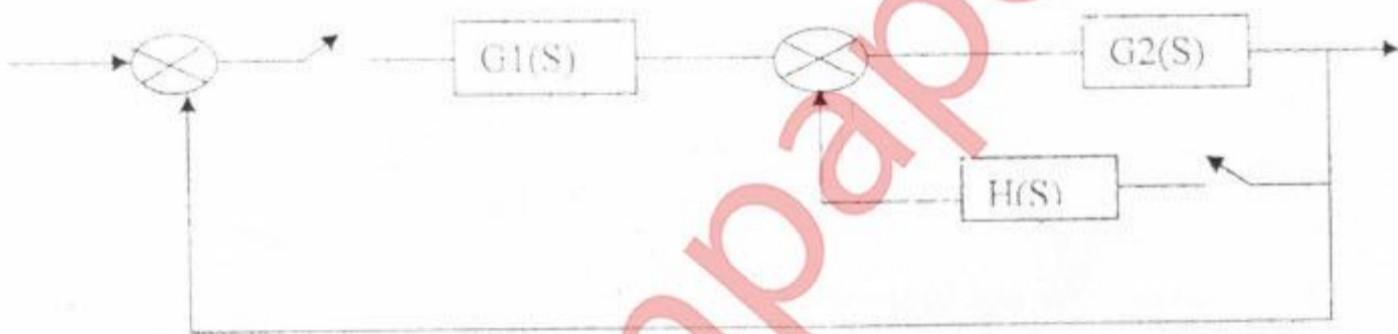
4. a) What do you understand by dead beat response of an observer? Design a state observer to obtain dead beat response for the system given below: 10

$$G = \begin{bmatrix} 1 & T \\ 0 & 1 \end{bmatrix}, \quad H = \begin{bmatrix} \frac{T^2}{2} \\ T \end{bmatrix}, \quad C = [1 \quad 0]$$

Use transformation matrix method and verify your result using Ackerman's Formula.

- b) Derive the expression for transfer function of first order hold with neat input/output characteristics. 10

5. a) The block diagram of the system is shown below, using concept of signal flow graph determine $C(Z)/R(Z)$. 10



- b) Check the stability of the system using Jury's stability test. 10

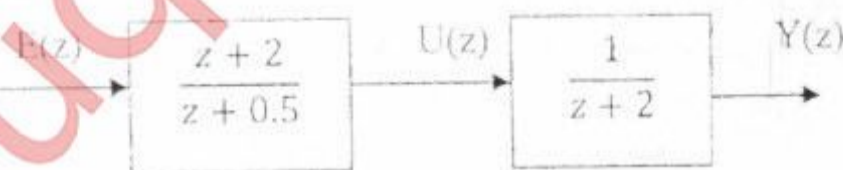
i) $z^4 - 1.368z^3 + 0.4z^2 + 0.08z + 0.007 = 0$

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

6. a) Write short note on bumpless PID controller with $T_c = S$. Determine discrete time PID controller if we have following continuous time PID settings: $K=2$, $\tau_d=2.5$ s, $\tau_i=40$ s, $\tau_s=1$ s. 10

- b) Study the effect of stabilizing the following system with controller that has a zero at $z=-2$. 10

$G(z) = \frac{1}{z+2}$ as shown in figure below



Course B.E.(Instrumentation)(Sem-VIII)(CBSGS) (Prog-T5228)

QP Code: 722200

Correction:



2. a) Obtain the pulse transfer function for the following system.

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$$y(k) = [1 \ 0 \ 0]$$

b) A discrete time regulator system has a plant-

10

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ -4 & -2 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(k)$$

Instead make it as

2. a) Obtain the pulse transfer function for the following system.

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$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -2 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(k)$$

Date and Time 12/05/2016 11:50 AM

BIK - 08

BIK - 09

Shukta (Reliver)
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