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BIEEE-002

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

00816

June, 2016

BIEEE-002 : DIGITAL CONTROL SYSTEM

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is allowed. Missing data, if any, may be suitably assumed.*

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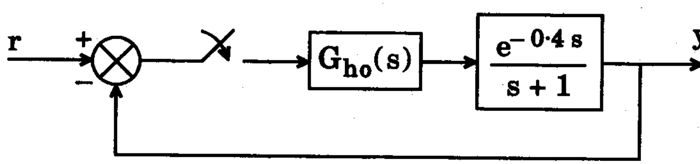
1. Consider the sampled data system as shown in the figure with process lag as $T_d = 0{\cdot}4$.



Obtain the pulse transfer function. *10*

2. Find the inverse Z-transform of *10*

$$f(z) = \frac{2z}{z^2 - 1 \cdot 2z + 0{\cdot}5}.$$

3. A discrete time system is described by the transfer function

$$G(z) = \frac{Y(z)}{R(z)} = \frac{1}{z^2 + a_1 z + a_2}$$

where, $a_1 = -\frac{3}{4}$, $a_2 = \frac{1}{8}$

Find the response y(k) to the input $r(k) = \delta(k)$. *10*

4. Obtain the state variable model of the given transfer function in first and second companion form *10*

$$G(z) = \frac{4z^3 - 12z^2 + 13z - 7}{(z-1)^2 (z-2)}.$$

5. A unity feedback system is characterized by the open loop transfer function

$$G_{ho} \, G(z) = \frac{0{\cdot}2385 (z + 0{\cdot}8760)}{(z-1)(z - 0{\cdot}2644)}.$$

The sampling period is T = 0·2 sec. Determine the steady state errors for unit step and unit ramp inputs. *10*

6. Solve for y(k) the equation

$y(k) = r(k) - r(k-1) - y(k-1), \; k \geq 0$

where,

$$r(k) = \begin{cases} 1; & k \text{ even} \\ 0; & k \text{ odd} \end{cases}$$

$y(-1) = r(-1) = 0.$ *10*

7. Using Jury stability criterion, check if all the roots of the following characteristic equations lie within the unit circle : *10*

$$z^3 - 1{\cdot}3\, z^2 - 0{\cdot}08\, z + 0{\cdot}24 = 0$$

8. Prove that the bilinear transformation maps the left half of the s-plane into the unit circle in the z-plane. *10*

9. Write short notes on any ***two*** of the following : *2×5=10*

(a) Controllability and Observability.

(b) Max-Min Principle for Optimal Digital Control.

(c) Routh Stability Criterion.