M.E. (Elec.) 1st Semester Examination, 2012

THEORY OF DISCRETE AND DIGITAL SYSTEMS (EE-902)

Time : 3 Hours | Full Marks: 70

Answer SIX questions taking any TWO from each group

Group – A

1. a) Find the z-transform of the following two-sided sequence and show the region of convergence.

$$f(k) = \begin{cases} -2 ; k < 0 \\ (0.5)^k ; k \geq 0 \end{cases}$$

b) Find the z-transforms of (i) delayed and (ii) advanced discrete-time system using shifting theorem.

c) What is convolution sum? [5+4+2]

2. a) Obtain the z-transform of $G(s) = \frac{s}{(s+1)(s+2)^2}$ by using residue method.

b) Find the steady state error for the closed loop system shown in Fig.1 for an input of $r(t) = 1 + 2t$.

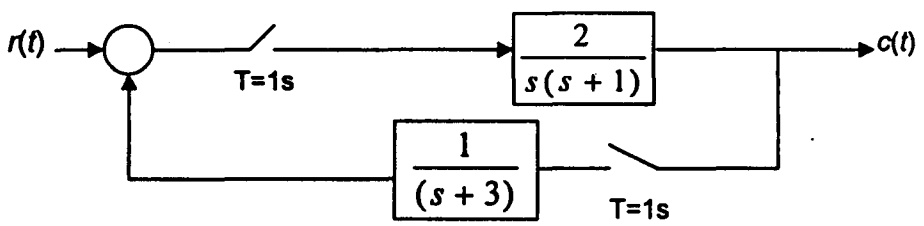

Fig. 1 [5+6]

3. a) Solve the difference equation: $2x(k) - 2x(k-1) + x(k-2) = u(k)$ for $k = 0,1,....4$; where $u(k)$ is a unit step sequence and $x(k) = 0$ for $k < 0$.

b) Find the inverse z-transform of $X(z) = \frac{z^{-2}}{(1-z^{-1})^3}$ using inversion integral method.

[6+5]

Group - B

4. a) Consider the system described by its input output difference equation: $y(k) - 0.6y(k-1) - y(k-2) + 0.7y(k-3) - 0.1y(k-4) = x(k)$. Determine stability of the system using (i) Jury's stability criteria and (ii) Routh's stability criteria.

b) Draw the *z*-plane mapping for the dotted region on s-plane in Figure 2.

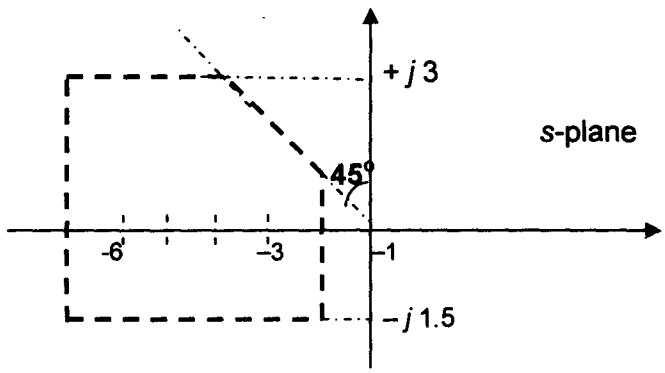

Fig. 2. [7 + 5]

5. a) What is modified *z*-transform and where it is used? Explain how modified *z*-transform can be obtained by sifting (advancing or delaying) a function from its normal sampling instants.

   b) Draw the signal flow diagram of the multi-rate sampling system shown in Fig. 3 and find the output $C(z)$.

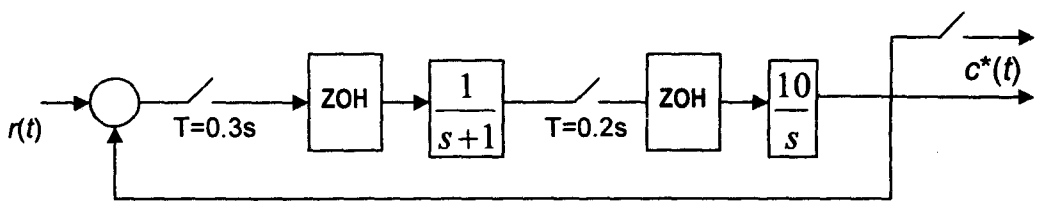

Fig. 3 [5 + 7]

6. Write critical notes on (any two): [6x2=12]

   (i) Frequency pre-warping in Bilinear Transformation.

   (ii) Frequency response curves for a ZOH and Reconstruction of discrete data.

   (iii) Parameters of Discrete time PID controller in terms of its analog counterpart.

   (iv) Velocity form of the discrete-time PID controller and its block diagram realization.

Group – C

7. a) What are the different configurations of digital filters? Describe the direct and indirect methods of realization of digital filters giving one example of each.

   b) State 'Transposition Theorem' and show its application in reconfiguration of a designed digital filter. Give a practical example using signal flow graph. What is a 'Self-Transposed' system?

[6 + 6]

8. a) Describe the realization of the Lattice type IIR filter with the help of structural diagram.

   b) Realize the following transfer function of a digital filter using ladder configuration:

$$H(z) = \frac{-1 + z^{-1} + \frac{3}{16} z^{-2}}{1 - \frac{1}{4} z^{-1} - \frac{1}{8} z^{-2}}$$

[6 + 6]

9. Write critical notes on (any two): [6x2=12]

   (i) Advantages of Digital filters & DSP chip.

   (ii) Wave Digital Filter.

   (iii) Effects of finite word length and computational error in numerical processing.

   (iv) Multiplier extraction technique in realization of digital filters.

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