M.E. (Elec.) 1st Semester Examination, 2013

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) With the help of first order approximation of Taylor's series expansion, establish the expression of Laplace Transform of the reconstructed signal $\overline{F}(s)$ from the discrete time function $f(kT)$. Comment why a sampler cannot be represented by a transfer function?

   b) From frequency domain consideration, show that a zero-order-hold can faithfully extract the original signal from discrete-time data. What is the limitation on sampling frequency? [6+5]

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

$$f(k) = \begin{cases} -4(0.5)^k : k < 0 \\ 3^k : k \geq 0 \end{cases}$$

   b) Using recursive method, find the pulse transfer function of a discrete-time causal system given by $y(k) = \sum_{h=0}^{k} r(h)$ for $k = 0, 1, 2, \ldots\ldots$ [5+6]

3. a) Obtain the z-transform of $G(s) = \dfrac{s+1}{(s+2)(s+3)}$ by using convolution integral in the right half plane.

   b) Find the z-transform of a system $G(s) = \dfrac{1}{(s+1)(s+3)}$ preceded by a ZOH. [5+6]

Group - B

4. a) Find the steady state error of the system shown in Figure 1 for an input $r(t) = 2 + t$.

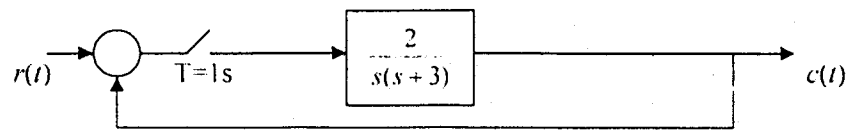

Fig. 1.

   b) Consider the system described by its input output difference equation given by: $y(k) - y(k-1) - 0.5y(k-2) + 2y(k-3) = x(k)$. Determine stability of the system using (i) Jury's stability criteria and (ii) Routh's stability criteria. [5+7]

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5. a) Draw the z-plane mapping for the dotted region on s-plane shown in Figure 2.

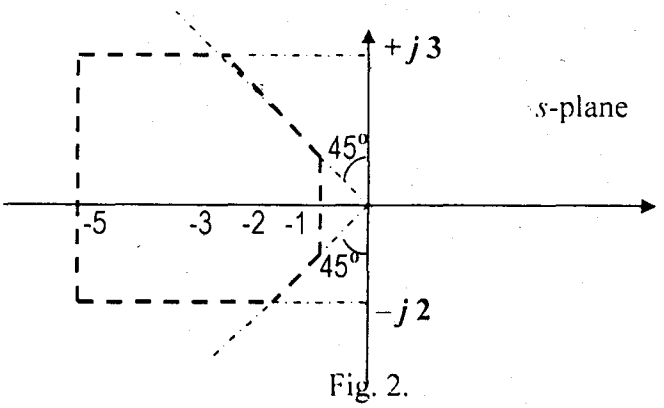

Fig. 2.

b) Find the parameters of the discrete-time PI controller corresponding to the analog PI controller shown in Fig. 3. Draw the velocity form of realization of the digital PI controller.

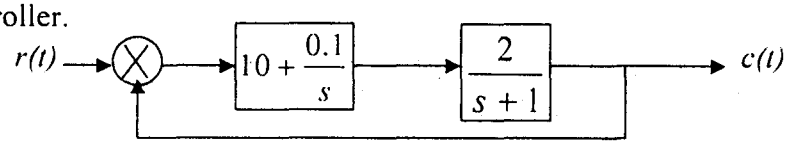

Fig. 3. [6 + 6]

6. a) How the data points in between the sampling intervals are computed using modified z-transform method? What are the application areas of this method?

b) Draw the signal flow graph of the multi-rate sampling system shown in Fig. 4 and find the output $C(z)$ in terms of $R(z)$.

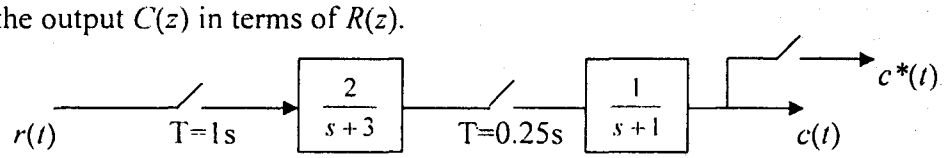

Fig. 4 [5+7]

Group – C

7. a) What is a digital filter? What are the IIR and the FIR type digital filters?

b) State and explain 'Transposition Theorem'. Show step-by-step decomposition of a block diagram of a digital filter using this theorem. [5+7]

8. a) What is a signal flow graph of a digital filter structure? State some rule of construction of signal flow graph from a structured representation of digital filter..

b) What is canonic form of realization? Realize the following transfer function of a digital filter using canonic configuration:

$$H(z) = \frac{1 + z^{-1}}{1 + \frac{1}{4}z^{-1} + \frac{1}{8}z^{-2}}$$ [6+6]

9. a) What is a DSP? Discuss a few important effects of finite word length in DSP.

b) What is a wave digital filter? Why is it called so? Explain with example. [6+6]

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