M.E. (Electrical) 1st Semester Examination, 2011

THEORY OF DISCRETE AND DIGITAL SYSTEMS (EE-902)

Time : 3 Hours | Full Marks: 70

Answer any FIVE questions
The questions are of equal value

1. a) With the help of data reconstruction by polynomial extrapolation, show that a sampler cannot be represented by a transfer function.

   b) Find the z-transform of the following single sided data sequence.

$$f(k) = \left[\frac{1}{k!}\right], \; k \geq 0$$

   c) How the signal is reconstructed by using a zero-order hold from a discrete time data? Explain with the help of frequency domain consideration. [4 + 4 + 6]

2. a) Find the pulse transfer function of a discrete-time system given by $y(k) = \sum_{h=0}^{k} r(h)$ for $k = 0, 1, 2, ...$ and $y(k) = 0$ for $k < 0$. Use recursive method.

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

   c) Find the z-transform of $G(s) = \frac{1-e^{-s}}{s} \cdot \frac{1}{(s+3)}$ as a product of two Laplace transformable functions. [5 + 4 + 5]

3. a) A digital PID controller is to replace an old analog system. Show the block diagram of the new retro-fitted system. If the old analog PID controller has the settings of Proportional gain=10, reset time =50s and the Rate time =0.5s. What will be the values of the PID parameters of the digital controller for the same performance? Given sampling time = 0.5s.

   b) Draw the z-plane mapping for the shaded region on s-plane shown in Figure 1.

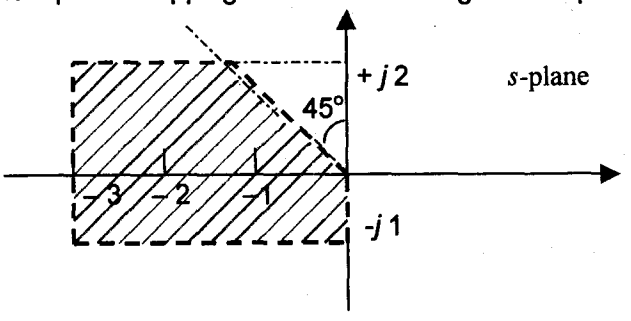

Fig. 1

   c) Use Jury's stability criterion to find the ranges of K for stability of the system given by characteristic equation: $F(z) = (z - e^{-2T})[4(z-1) + 2KT] - K(z-1)(1-e^{-2T}) = 0$, where sampling time is 0.4s. [4 + 5 + 5]

4. a) $f(t) = \begin{cases} e^{-2t}, t \geq 0 \\ 0 \quad , t < 0 \end{cases}$, Find $F(z)$ using convolution integral in RH-side of s-plane.

   b) Show that $F^*(s)$ is periodic with a period of $\frac{2\pi}{\omega_s}$

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

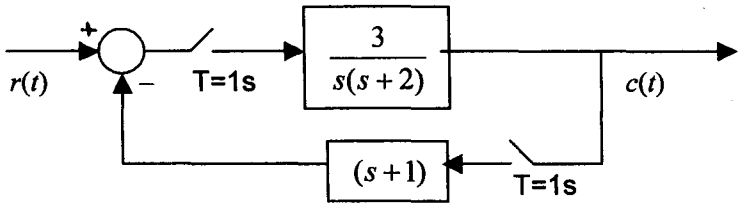

Fig. 2 [5 + 4 + 5]

5. a) What is Bilinear Transform? Why Frequency pre-warping is necessary for the design of discrete time controllers using Bilinear Transformation? Write down the steps of such design.

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

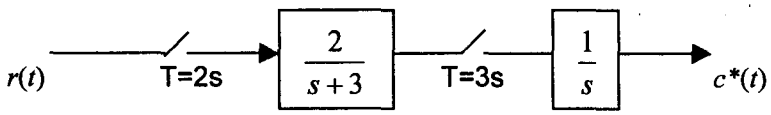

Fig. 3 [8 + 6]

6. a) What is Digital Filter? Classify different configurations of Digital Filters. What is DSP? Compare Digital Filter and DSP.

   b) State Transposition Theorem. With the help of an example apply Transposition Theorem on a self-transposed configuration. [7 + 7]

7. a) "Canonic form of configuration of Digital Filter requires minimum number of delay modules"- Discuss with an example.

   c) Why does Indirect Approach for Digital Filter result superior regarding Quantization Error or Effect of Finite Word-length. [7 + 7]

8. Write short notes on *any two* [7×2]

   a) Web Digital Filter

   b) Multiplier Extraction Technique in Digital Filter

   c) Comparison between IIR and FIR filters

   d) Lattice Form of realization of Digital Filter

   e) Effect of Finite Word-length in execution of Digital signal processing

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