JE – 996

II Semester M.E. (Control and Instrumentation) Degree Examination, July/August 2013
2K8 CI 211 : DIGITAL SIGNAL PROCESSING AND APPLICATIONS

Time : 3 Hours Max. Marks : 100

Instruction : *Answer* ***any five full*** *questions.*

1. a) Show that the unit impulse response h [n] of an LTI system can be used to evaluate the following :
   i) input-output relation
   ii) frequency response of the system. **8**

   b) For the system described by the II order difference equation
   $y[n] - 3y[n-1] - 4y[n-2] = x[n] + 2x[n-1]$, find
   i) the zero input response if $y[-1] = 1$ and $y[-2] = 0$
   ii) the response y [n] when $x[n] = 4^n u[n]$
   iii) the impulse response of the system. **12**

2. a) Define causality and stability of a LTI system. Obtain the conditions, in Z-domain, for a LTI system to be
   i) Causal and
   ii) Stable. **10**

   b) Evaluate the system properties of a LTI system defined by its system function
   $$H(z) = \frac{z+2}{2z^2 - 7z + 3}.$$ **6**

   c) Find the impulse response of a LTI system in closed form expression, if its system function is given by
   $H(z) = \log_e (1 + az^{-1}), |z| > |a|$ **4**

P.T.O.

3. a) State and prove windowing theorem in the frequency domain. **8**

   b) An LTI system is described by the following difference equation :

   $y[n] = a\, y[n-1] + b\, x[n],\ 0 < a < 1$

   i) find the frequency response of the system

   ii) find the response of the system when excited by the input

   $$x[n] = 5 - 10 \sin n\pi + 3 \cos\left(\frac{\pi}{4}n + \frac{\pi}{8}\right),\ -\infty < n < \infty$$

   given ; $a = 0.5$ and $b = 10$. **12**

4. a) Prove that the circular convolution of two sequences in the time domain is equivalent to multiplication of their DFTs in the frequency domain. **8**

   b) An LTI system is described by the following input-output relationship :

   $$y[n] = \frac{1}{2}\, y[n-1] - \frac{1}{4}\, y[n-2] + x[n] + x[n-1]$$

   Realize this system in the following forms :

   i) Cascade form

   ii) Parallel form. **12**

5. a) Illustrate the Radix-2 decimation in time FFT algorithm, with mathematical analysis. Compare its computational complexity with the direct computation of DFT. **14**

   b) Discuss the design specifications of a digital filter. **6**

6. a) Discuss the efficacy of different types of window functions used for the design of FIR filters, along with their parameters. **12**

   b) Find H (z) of a IIR filter using impulse invariant technique for the following analog system function ;

   $$H(s) = \frac{1}{(s + 0.5)\,(s^2 + 0.5\, s + 2)}.$$ **8**

7. Write short notes on :

   a) Spectral estimation. **7**

   b) Butterworth filters Vs. Chebyshev filters. **8**

   c) Limit cycle oscillations in IIR filters. **5**