EJM – 019

II Semester M.E. (Control and Instrumentation) Degree Examination, January 2013
2K8 CI 211 : DIGITAL SIGNAL PROCESSING AND APPLICATION

Time : 3 Hours Max. Marks : 100

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

1. a) Show that 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, and
   iii) Stability. **9**

   b) Using concept of orthogonality, explain how the signals are represented orthogonally. Explain with an example. **11**

2. a) Find the impulse response of an LTI system, in closed form, if the system function is given by $H(z) = \text{Log}_e (1+az^{-1})$, $|z| > a$. **10**

   b) Determine the cross-correlation of sequence of $r_{x_1x_2}$ (l) the sequences :
   $x_1(n) = \{\underset{\uparrow}{1}\ 2\ 3\ 4\}$
   $x_2(n) = \{\underset{\uparrow}{4},\ 3\ 2\ 1\}$. **6**

   c) State any four properties of z-transform. **4**

3. a) Prove that the sampling of Fourier transform of a sequence x(n) results in N-point DFT, using which both the sequence and the transform can be reconstructed. **10**

   b) State and prove the following properties of DFT :
   i) Frequency shift.
   ii) Convolution in time domain.
   iii) Linearity. **10**

4. a) Explain symmetric properties of DFT. **10**

   b) Using DFT properties which relates Linear convolution to circular convolution, obtain the output of a linear filter given the impulse response h(n) = { 1, 1, 1 } and input to be a long sequence
   x(n) = {1, 2, 0, –3, 4, 2, –1, 1, –2, 3, 2, 1, –3}. **10**

P.T.O.

5. a) What is FFT ? Give its importance in digital signal processing. **5**

   b) Derive the Radix-2 DIT-FFT algorithm to compute DFT of an N = 8 point sequence and draw complete signal flow graph. **7**

   c) Using DIT-FFT find the sequence x(n) corresponding to 8 point DFT, where X(K) is given by
   X(K) = {4, 1–j2.414, 0, 1–j0.414, 0, 1+j0.414, 0, 1+j2.414} **8**

6. a) Show that DFT can be used to evaluate the convolution of finite duration sequence $x_1(n)$ and $x_2(n)$ of length N_1 and N_2 respectively. **8**

   b) How can one design digital filters from analog filters ? **4**

   c) Design a digital Butterworth filter H(z) given an equivalent analog filter with the following specifications :
   Pass Band Ripple $\leq$ 3dB
   Stop Band Edge Frequency 750 Hz
   Stop Band Attenuation of 15 dB
   Pass Band Edge frequency 500 Hz and Sampling rate is 2 kHz.
   Design using Bilinear transformation. **8**

7. a) Explain the frequency sampling design of FIR filters and realize it in DF structure. **5**

   b) Write short notes on “Spectral estimation”. **7**

   c) The desired frequency response of LPF if

$$H_d(e^{j\omega}) = e^{-j3\omega} \quad \frac{-3\pi}{4} \leq \omega \leq \frac{3\pi}{4}$$

$$= 0 \quad \frac{-3\pi}{4} \leq |\omega| \leq \pi$$

   Design using Hamming window M = 7. **8**
