Roll No .....

MEVD - 104

M.E./M. Tech., I Semester

Examination, December 2015

Digital Signal Processing

Time : Three Hours *Maximum Marks : 70*

Note: i) Attempt any five questions.
ii) All questions carries equal marks.

1. a) State sampling theorem. For any analog signal how the sampling rate is selected? Also discuss that if the sampling is performed at minimum sampling rate how reconstruction is done?
   b) Consider the analog signal: $Xa(t) = 3 \cos 100 \pi t$.
      i) Determine the minimum sampling rate required to avoid aliasing.
      ii) Suppose that the signal is sampled at the rate Fs = 75Hz. What is the discrete time signal obtained after sampling?
      iii) What is the frequency $0 < F < Fs/2$ of a sinusoid that yields samples identical to these obtained in part (ii).

2. a) State and prove the following properties of Z-transform:
      i) Time shifting
      ii) Differentiation in Z-domain
   b) Determine the Z-transform and the ROC of the signal: $X(n) = [3(2n)–4(3n)]4(n)$

3. a) Let X(k) be the N-point DFT of the sequence x(n), $0 \le n \le N-1$. What is the N-point DFT of the sequence s(n), X(n) $0 \le n \le N-1$?
   b) State and prove the following properties of DFT:
      i) Circular convolution
      ii) Time Reversal of a sequence

4. a) Compare in detail the computational complexity for the direct computation of the DFT versus the FFT algorithm.
   b) Draw and explain the flow graph of eight point decimation in time FFT algorithm.

5. a) Discuss design of FIR digital filters using window method. Explain different types of windows used in the window design method.
   b) Design an ideal highpass filter with a frequency response:

$$H_d\left(e^{j\omega}\right) = 1 \quad for \frac{\pi}{4} \le |\omega| \le \pi$$

$$= 0 \qquad |\omega| < \frac{\pi}{4}$$

Using a hanning window with M=11 and plot the frequency response.

6. a) Discuss design of IIR digital filters using Butterworth approximation. Draw and explain its frequency response characteristics.
   b) Design a digital band pass filter from a 2^{nd} order analog low pass Butterworth prototype filter using bilinear transformation. The lower and upper frequencies for band pass filter are $5\pi/12$ and $7\pi/12$. Assume T = 2 sec.

7. a) Explain the effect of finite register length if FIR filter design.
   b) Draw and explain the flow graph of four point decimation in frequency FFT algorithm.

8. a) How pipelining results in increased throughput of the DSP's? Explain in detail.
   b) Discuss in detail designing of programmable DSPs.

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