8. a) Consider an LTI system whose response to the input

$$x(t) = \left[e^{-t} + e^{-3t} \right] u(t) \text{ is } y(t) = \left[2e^{-t} - 2e^{-4t} \right] u(t)$$

      i) Find the frequency response of this system.

      ii) Determine the system's impulse response.

   b) Discuss about the non-linear equation solution of maximal ripple FIR filter.

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Roll No ....

MEMT-202

M.E./M.Tech., II Semester

Examination, December 2015

Digital Signal Processing

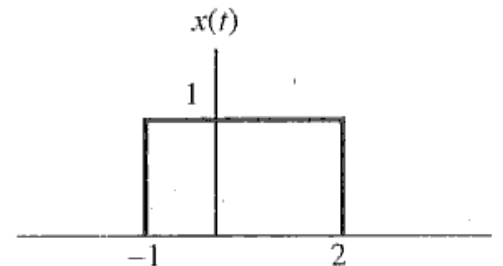*Time : Three Hours*

Maximum Marks : 70

Note: i) Attempt any five questions.

      ii) All questions carry equal marks.

1. a) i) Consider an LTI system with input and output related through the equation :

$$y(t) = \int_{-\infty}^{t} e^{-(t-x)} x(\tau - 2) \, d\tau$$

What is the impulse response $h(t)$ for this system?

      ii) Determine the response of the system when the input $x(t)$ is as shown below :

b) A causal LTI system is described by the difference equation $y[n] = y[n-1] + y[n-2] + x[n-1]$.

i) Find the system function $H(z) = Y(z) / X(z)$ for this system. Plot the poles and zeroes of $H(z)$ and indicate the region of convergence.

ii) Find the unit sample response of the system.

iii) You should have found the system to be unstable. Find a stable (but non-causal) unit sample response which satisfies the difference equation.

2. a) Discuss design of FIR digital filters using window method. Explain different types of windows used in the window design method.

b) Design a Low Pass FIR filter using frequency sampling technique having cutoff frequency of $\pi/2$ rad/sample. The filter should have linear phase and length of 17.

3. a) What do you understand by phase response and group delay? Explain the significance of each of them.

b) Write short notes on :

i) Matched Z-transform

ii) Properties of IIR filters

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) Explain briefly about the Digital matched filters for Radar signals.

b) Explain about Air borne surveillance Radar for air traffic

6. a) The following is known about a discrete - time LTI system with input $x[n]$ and output $y[n]$:

i) If $x[n] = (-2)^n$ for all n, then $y[n] = 0$ for all n.

ii) If $x[n] = \left(\dfrac{1}{2}\right)^n U(n)$ for all n, then $y[n]$ for all n is

of the form $y[n] = \delta[n] + a\left(\dfrac{1}{4}\right)^x u[n]$, where a is a constant.

1) Determine the value of the constant a.

2) Determine the response $y[n]$ if the input $x[n]$ is $x[n] = 1$ for all n.

b) State and prove the following properties of Z-transform

i) Time shifting

ii) Differentiation in Z-domain

7. a) Explain the effect of finite word length in FIR filter design

b) Draw and explain the flow graph of four point decimation in frequency FFT algorithm.