Code No: NR410201 **NR**

IV B.Tech I Semester Supplementary Examinations, November 2005
DIGITAL SIGNAL PROCESSING
(Common to Electrical & Electronic Engineering and Information Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Consider a LSI system with unit sample response $h(n)n = \alpha^n u(n)$ where α is real and $0 < \alpha < 1$. If the input is $x(n) = \beta^n\, u(n), 0 < |\beta| < 1$,determine the the output f(n) in the form $y(n) = (k_1\alpha^n + k_2\beta^n u(n)$ by explicitly evaluating the convolution sum.
   (b) Define causality and stability of LSI system and state the conditions for stability.

   [12+4]

2. (a) If x(n) $\rightarrow x(e^{j\omega})$ Constitute a Fourier transform pair. Prove the following:

Sequence	Fourier Transform
i. x*(n)	$X * (e^{-j\omega}$
ii. $x_o(n)$	$jIm[X(e^{j\omega}]$

   (b) Let x(n) and $X(e^{j\omega})$ represent a sequence and its transform. Determine, in terms of $X(e^{j\omega})$, the transform of each of the following sequences :
   i. $g(n) = \begin{cases} x(n/2) & n \ even \\ 0 & n \ odd \end{cases}$
   ii. $x^2(n)$

   [8+8]

3. (a) Prove the following properties
      i. $arg[X(K)] = -arg[X((-K)_N)R_N(K)]$
      ii. $Im[X(K)] = -Im[X((-K))_N R_N(K)]$
   (b) If X(K) denotes the N-point DFT of N-Point sequence x(n), show that with N even and if x(n) = x(N-1-n) then X(N/2)=0. [8+8]

4. (a) Explain the inverse FFT algorithm to compute inverse DFT of a N=8. Draw the flow graph for the same.
   (b) Compute the FFT for the sequence { 1, 0, 0, 0, 0, 0, 0, 0 } [8+8]

5. (a) An LTI system is described by the equation y(n)=x(n)+0.81x(n-1)-0.81x(n-2)-0.45y(n-2). Determine the transfer function of the system. Sketch the poles and zeroes on the Z-plane.
   (b) Define stable and unstable system test the condition for stability of the first-order IIR filter governed by the equation y(n)=x(n)+bx(n-1). [8+8]

6. Design a Digital IIR low pass filter with pass band edge at 1000 Hz and stop band edge at 1500 Hz for a sampling frequency of 5000 Hz. The filter is to have a pass band ripple of 0.5 db and stop band ripple below 30 db. Design Butter worth filler using both impulse invariant and Bilinear transformations. [16]

7. A low pass filter is to be designed with the following desired frequency response.
$H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega}, -\pi/4 \leq \omega \leq \pi/4 \\ 0, \quad \pi/4 \leq |\omega| \leq \pi \end{cases}$
Determine the filter coefficients $h_d(n)$ if the window function is defined as
$\omega(n) = \begin{cases} 1, \ 0 \leq n \leq 4 \\ 0, \ otherwise \end{cases}$
Also determine the frequency response $H(e^{j\omega})$ of the designed filter. And plot the magnitude and phase spectra. [16]

8. (a) Explain in detail the short time Fourier analysis for speech signals
   (b) What is a vocoder? Explain with a block diagram. [10+6]

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