Code No: NR320402 **NR**

III B.Tech II Semester Supplementary Examinations, November/December 2005

DIGITAL SIGNAL PROCESSING

(Common to Electronics & Communication Engineering, Electronics & Instrumentation Engineering, Electronics & Control Engineering and Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. For each of the following discrete-time signals, determine whether or not the system is linear, shift-invariant, causal and stable.
   (a) y(n)=x(n + 7)
   (b) $y(n) = x^3(n)$
   (c) y(n) =nx(n)
   (d) $y(n) \ = \alpha + \sum\limits_{k=0}^{4} x(n-k), \alpha$ is a non zero constant.

   [12+4]

2. (a) Show that the frequency response of a discrete system is a periodic function of frequency.
   (b) Obtain the frequency response of the first order system with difference equation y(0) = x(n)+10y(n-1) with initial condition y(-1) = 0 and sketch it comment about its stability.
   (c) State and prove the frequency shifting property of Fourier transform.

   (a) Let x(n) and $X(e^{jw})$ represent a sequence and its transform. Determine, in terms of $X(e^{jw})$, the transform of each of the following sequences :
      i. k x(n), k = any constant
      ii. $x(n - n_0)$, n_0 = a real integer
   (b) By explicitly evaluating the transforms $X(e^{jw}), H(e^{jw}) and Y(e^{jw})$ corresponding to x(n), h(n) and y(n) specified in part (a) show that $Y(e^{jw}) = H(e^{jw})X(e^{jw})$

   [5+6+5]

3. (a) Prove the following properties.
      i. $x^*(n) \rightarrow X^*((-K))_N R_N(K)$
      ii. $x^*((-n))_N R_N(n) \rightarrow X_{ep}(k) = 1/2[X((K))_N + X^*((-K))_N]R_N(K)$
   (b) Let X(K) denotes the N-point DFT of the N-point sequence x(n) show that if x(n) satisfies the relation $x(n) = -x(N-1-n) then X(0) = 0$. [8+8]

4. An 8 point sequence is given by x(n) = {2,2,2,2,1,1,1,1}. Compute 8 point DFT of x(n) by

(a) radix - 2 D I T F F T

(b) radix - 2 D I F FF T
Also sketch magnitude and phase spectrum. [16]

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. A digital low pass filter is required to meet the following specifications
Pass band attenuation $\leq 1db$
Pass band edge 4 KHz
Stop band attenuation $\geq 40db$, Stop band edge = 8KHz
Sample rate 24 KHz
The filter is to be designed by performing a bilinear transformation on an analog system function. Design a butter worth filter and realize it. [16]

7. (a) Outline the steps involved in the design of FIR filter using windows.

   (b) Determine the frequency response of FIR filter defined by y(n) = 0.25x(n)+ x(n-1)+ 0.25x(n-2). Calculate the phase delay and group delay. [8+8]

8. (a) What are the advantages in cascade and parallel realisation of IIR systems

   (b) The transfer function of a system is given by

$$H(Z) = \frac{\left(1+Z^{-1}\right)^3}{\left(1-\frac{1}{4}Z^{-1}\right)\left(1-Z^{-1}+\frac{1}{2}Z^{-2}\right)}$$

[6+10]

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