C 58308 (Pages : 2) Name.........................

Reg. No......................

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION JUNE 2009

IT 2K 601—DIGITAL SIGNAL PROCESSING

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Part A

1. What is the type of filter represented by the impulse response $h(n) = \{1, 1\}$?

2. Determine, whether the system with impulse response $h(n) = (0,6)^n\, u[n+2] + (0.5)^n u[-n]$ is causal and/or stable. Justify your answer.

3. Realize the filter $H(z) = \left(1 + \frac{1}{2} z^{-1} + z^{-2}\right)\left(1 + \frac{1}{4} z^{-1} + z^{-2}\right)$ in cascade form with minimum number of multipliers.

4. Discuss the finite word length effect in FIR filters.

5. Explain the phenomenon of frequency wrapping and its effect in bilinear transformation.

6. Determine the cut-off frequency of the low-pass filter $H(z) = \dfrac{1 + 2x^{-1}}{4 - x^{-2}}$.

7. Compute the N point DFTs of

$$x(n) = \begin{cases} 1;\, 0 \le n \le \frac{N}{2} - 1 (N - \text{even}) \\ 0;\, \frac{N}{2} \le n \le N-1, \text{ otherwise.} \end{cases}$$

8. Compare the features of FIR and IIR filters.

(8 × 5 = 40 marks)

Part B

1. (a) For the two systems below, determine whether or not it is : linear, time invariant, causal, stable, and memory less

$$y[n] = \begin{cases} x[n], & x[n] < |n| \\ |n|, & \text{else,} \end{cases} \qquad y[n] = \frac{1}{3}\{(x[n] - x[n-1]) + 1\}.$$

(b) Find the impulse response of the system described by the difference equation,

$$y[n] = (x[N] + 2x[n-1] + x[n-2])/4.$$

Or

Turn over

2. (a) State and prove the condition for stability of an LTI system.

   (b) Plot the output for an input $x(n) = U(n) - U(n-N)$ to a system with impulse response

   $h(n) = a^n U(n)$ for $|a| > 1$ and for $|a| < 1$.

3. (a) The impulse response of a five point moving average system is $h(n) = \begin{cases} \frac{2}{5}; 0 \le n \le 4 \\ 0; \text{otherwise.} \end{cases}$

   Determine and plot the magnitude and phase of $H(e^{jw})$.

   (b) Find the DTFT and the DFT of $x[n] = [1 -1]$. Sketch $X(\omega)$ for $-\pi < \omega < \pi$ for the DTFT and the magnitude and phase plots for the DFT part.

Or

4. (a) With examples, differentiate between DFS and DFT. State and prove Parseval's theorem.

   (b) Let $g[n] = \begin{cases} 1, 0 \le n \le 5 \\ 0, 6 \le n \le 7 \end{cases}$ be a periodic signal with fundamental period N = 8. Determine the Fourier series coefficients of the signal $g[n]$.

5. (a) The desired frequency response of a low-pass filter is $H_a(e^{jw}) = \begin{cases} 1; -\frac{\pi}{2} \le \omega \le \frac{\pi}{2} \\ 0; \frac{\pi}{2} \le \omega \le \pi. \end{cases}$

   Design the filter with rectangular window of N = 7.

   (b) Explain the frequency sampling method of FIR filter design.

Or

6. (a) Convert the analog filter with system function $H_a(s) = \frac{(s+2)}{(s+1)(s+3)}$ into the digital filter by means of impulse invariant transformation.

   (b) Explain the matched Z transform technique of IIR filter design.

7. (a) A filter is given by the unit sample response

   $$h(n) = \begin{cases} a^n, 0 \le n \le 7; |a| \le 1 \\ 0; \text{otherwise.} \end{cases}$$

   Realize the system as a cascade of FIR with an IIR system.

   (b) Explain the effect of finite word length in FIR and IIR systems.

Or

8. (a) Realise the filter $y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.252x(n-2)$ in direct form-II, cascade and parallel structures.

   (b) Discuss the realization structures for FIR systems and compare them.

(4 × 15 = 60 marks)