Reg. No. : | | | | | | | | | | | |

M 2482

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Fifth Semester

Information Technology

IF 351 — DIGITAL SIGNAL PROCESSING

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State whether $y(n)=ax(n)$ is static, linear, shift invariant, causal and stable.

2. Differentiate between recursive and nonrecursive systems.

3. Determine the z –transform of the signal

$x(n) = a^n u(n)$

4. What is meant by spectral leakage in DFT computation?

5. Draw the butterfly diagram for radix-2 DIT algorithm for $N = 4$.

6. Mention the effects of quantization in digital filters.

7. What is the need for window functions in FIR filters?

8. What is bilinear transformation?

9. What is the effect of decimation on frequency response?

10. What is subband coding?

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Determine the z-transform and ROC of the signal $x(n)=\left[6\left(3^n\right)-7\left(4^n\right)\right]u(n)$ (8)

(ii) Determine the convolution of two sequences $x(n)=(4,2,3,1), y(n)=(2,3,1,2)$ (8)

Or

(b) (i) Determine the solution $y(n), n \geq 0$ to the difference equation

$$y(n)=\frac{5}{6}y(n-1)-\frac{1}{6}y(n-2)+x(n) \text{ for } x(n)=2^n u(n)$$ (8)

(ii) Check if the discrete - time system represented by the following difference equation is linear, shift invariant and causal.

$y(n)=3y^2(n-1)-nx(n)+4x(n-1)-2x(n+1);\ n \geq 0$. (8)

12. (a) (i) Derive the DFT of the sample data sequence $x(n)=\{1,1,1,0\}$ and compute the corresponding amplitude and phase spectrum. (10)

(ii) List and explain any four properties of DFT. (6)

Or

(b) (i) Given $x(n)=\{1,2,3,4,4,3,2,1\}$ find $X(k)$ using DIT–FFT algorithm. Illustrate using flow graph. (8)

(ii) Draw the butterfly flow graph of 8 point decimation-in-frequency FFT algorithm. (8)

13. (a) (i) Develop the cascade realization structure for

$$y(n)=\frac{3}{4}y(n-1)-\frac{1}{8}y(n-2)+x(n)+\frac{1}{3}x(n-1)$$ (10)

(ii) Draw the direct form II realization structure of a third order IIR system. (6)

Or

(b) (i) Determine the direct form I realization for a third order IIR transfer function

$$H(z)=\frac{0.28z^2+0.319z+0.04}{0.5z^3+0.3z^2+0.17z-0.2}.$$ (8)

(ii) Obtain the parallel realization of

$$H(z)=\left(1+\frac{1}{2}z^{-1}\right)\left(1+\frac{1}{2}z^{-1}+\frac{1}{4}z^{-2}\right)$$ (8)

14. (a) Design a filter with $H(e^{jw}) = e^{-j3w}$ for $\frac{-\pi}{4} \le w \le \frac{\pi}{4}$
$= 0$ for $\frac{\pi}{4} \le |w| \le \pi$. Using Hamming window for $N = 7$. (16)

Or

(b) Design a Butterworth filter satisfying the following constraints

$0 \le |H(e^{jw})| \le 1 \quad 0 \le w \le \frac{\pi}{2}$

$|H(e^{jw})| \le 0.2 \quad \frac{3\pi}{4} \le w \le \pi$

With $T = 1$ sec. Apply impulse invariant transformation. (16)

15. (a) What is meant by down sampling? Derive an expression for the spectrum of the down sampled signal. (16)

Or

(b) Write notes on :

(i) Subband coding of speech signals

(ii) Musical sound processing. (8 + 8)
