B.E / B.Tech (Full-Time) Degree End Semester Examinations, April/May 2012

Anna University, Chennai

Computer Science and Engineering

Sixth Semester

CS9351 – Digital Signal Processing
(Regulations 2008)

Time: 3 Hrs. Max Marks: 100

Answer ALL Questions

Part A – (10 * 2 = 20 marks)

1. If $y(n) = x(n) * h(n)$ show that $\sum_y = \sum_x \sum_h$ where $\sum_y = \sum_{n=-\infty}^{\infty} y(n)$
2. Prove the Parseval's theorem.
3. Prove that if x(n) is real and even, then X(k) is also real and even.
4. Express the computation of Discrete Cosine transform and its inverse.
5. Explain the relationship between the digital and analog frequency in the Impulse invariance technique of converting analog filter to digital filter.
6. Convert the following analog filter to digital filter using approximation of derivatives with T = 1 sec. $H(s) = \frac{1}{s^2+0.2}$
7. Why do we not choose Rectangular window for designing FIR filters? In that situation which window do we prefer.
8. Determine the deadband of the first order filter system given by

   $y(n) = x(n) - 0.8y(n-1)$

9. Prove or Disprove: "Segmentation is very important module of an image processing system".
10. Explain how do you achieve fractional decimation and represent this using a block diagram.

Part A – (5 * 16 = 80 marks)

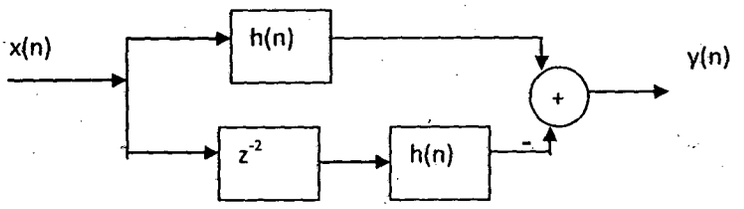
11. i. State whether the following systems are static, linear, time invariant, causal and stable
    a. $y(n) = x(-n)$ (4)
    b. $y(n) = n\, x(n+1)$

    ii. Determine the impulse response h(n) of the signal if the system is described as (6)

    $y(n) - 3\, y(n-1) - 4\, y(n-2) = x(n)$

    iii. Determine the response of the system given in figure

    $h(n) = (n+1)\, u(n)$ and $x(n) = u(n+5) - u(n-10)$ (6)



12. a. i. Determine the Z- transform and the ROC of the following signal. (6)

$$x(n) = \begin{cases} \left(\frac{1}{2}\right)^{-n}, & n < 0 \\ \left(\frac{1}{3}\right)^{n}, & n \geq 0 \end{cases}$$

ii. Determine the circular convolution of the eight point sequences given by (6)

$x_1(n) = \left(\frac{1}{4}\right)^n \quad 0 \leq n \leq 7$

$x_2(n) = \cos\frac{3n\pi}{8} \quad 0 \leq n \leq 7$

iii. Distinguish Overlap add and Overlap save method and explain its use in detail. (4)

(OR)

b. i. Derive the expression to compute FFT using Decimation in Time algorithm and explain the savings in time when compared to DFT. (8)

ii. Compute the FFT of the following sequence using Decimation in Time algorithm

$x(n) = \{ 1, 2, 3, 4, 5, 6, 7, 8\}$ (8)

13. a. i. Design an IIR butterworth low pass digital filter satisfying the following constraints

Passband Gain = 0.95

Passband edge = 0.5π

Stop Band Gain = 0.15

Stop band edge = 0.7π

Use Bilinear transformation with T = 1sec. Realise this using Direct form I (10)

ii. Convert the following analog filter to digital filter using Impulse invariance technique with T = 1 sec (6)

$$A = \frac{s + 0.1}{(s + 0.1)^2 + 9}$$

(OR)

b. i. Determine the order of the following filter that uses Chebyshev approximation. (6)

Pass band frequency = 1000π, Pass band ripple = 1 dB

Stop band frequency = 2000π, Stop band attenduation = 40 dB

ii. Determine the Cascade and Parallel realisation of the following system and represent them using Direct form II transpose structure. (10)

$$H(z) = \frac{(z-1)(z+0.5)(z-0.2)}{(z-2)(z-0.1)(z-0.5)}$$

14. a. i. Design a digital FIR filter using Hamming window for the following specifications. (10)

$$H_d(\omega) = \begin{cases} e^{-j4\omega}, & |\omega| < \frac{\pi}{6} \\ 0, & else \end{cases}$$

ii. Write short notes on the Errors that occur in a typical Digital Signal processing system (6)

(OR)

b. Design a digital FIR filter using frequency sampling technique for the following specification with 13 coefficients. Realise this filter using Direct form I with linear phase. (16)

Pass band frequency = 0.4π, Stop band frequency = 0.6π

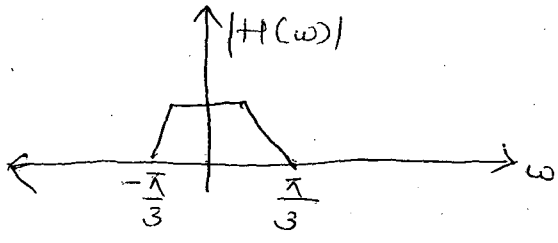
15. a. Write short notes on the following

a. Speech Processing (10)

b. Image Enhancement (6)

(OR)

b. i. Explain the Decimator with a neat block diagram and justify the need for an anti-aliasing filter. Show the process of Decimation for the following system response by 3. (6+4)



c. Write short notes on Adaptive Echo cancellation. (6)