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B.E. DEGREE EXAMINATIONS: MAY/JUNE 2013

Sixth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

EIE112 **:** Digital Signal Processing

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. A discrete-time signal is given by x(n) = {1, -1, 1, -1, 0, 1, 1}. The signal is :
   a) odd b) recursive
   c) odd and even d) anti-causal
2. A CT signal x(t) = cos(2πt) + sin(2000t) is to be sampled. The Nyquist rate for the signal is :
   a) >2000 b) 1000/π
   c) 4000 d) 2000/π
3. The transfer function of a DT system is given by:
   $H(z) = \frac{1}{1-2z^{-1}+3z^{-2}}$ The system can be :
   a) stable b) causal
   c) stable and causal d) non-recursive
4. The impulse response of a LTI system is δ(n). The response of the system to the input $x(n) = e^{-j3n}$ is :
   a) δ(n) b) e^{-j3n}
   c) e^{j3n} d) u(n)
5. The response of a LTI system can be efficiently computed using :
   a) circular convolution b) linear convolution
   c) DFT d) FFT
6. The symmetry property of twiddle factor is :
   a) $W^{(k+N/2)} = W^k$ b) $W^{(k+N)} = W^k$
   c) $W^{(k+N/2)} = -W^k$ d) $W^{(k+N)} = -W^k$
7. If the response of a digital filter is a scaled and shifted version of the input, the filter is :
   a) stable b) linear phase
   c) unstable d) recursive
8. The smallest transition width is attained in ---------- window:
   a) Rectangular b) Hamming
   c) Hanning d) Blackmann

9. The two sequences x(n) = {1,2,2,1} and h(n) = {1} are convolved using circular convolution. The resulting sequence length is :

a) 4 b) 5

c) 3 d) 1

10. TMS320C54xx is :

a) floating point b) fixed point

c) microcontroller d) peripheral

PART B (10 x 2 = 20 Marks)

11. A LTI system is described by: y[n] = 2y[n-2] – 4y[n-1] + 4x[n]. Is the system recursive? Justify the answer.
12. What is aliasing? Give an example.
13. What is the condition for a discrete-time system to be causal and stable?
14. Find the Fourier transform of : x[n] = {3, 5, 7, 0, -1, -3}
    ↑
15. Draw the basic butterfly structure for radix-2 DIF algorithm.
16. If N= 2048, what is the reduction in computations obtained in applying FFT compared to DFT?
17. Illustrate Gibb's phenomenon. How can it be reduced?
18. Explain warping effect.
19. Compare Harvard and Von Neumann architectures.
20. What is bit-reversed addressing?

PART C (5 x 14 = 70 Marks)

21. a) (i) Explain any three properties of discrete time systems. (6)

    (ii) Consider the analog signal x(t) = 3cos(100πt). Determine the minimum sampling rate required to avoid aliasing. If the signal is sampled at a rate of 200Hz, what is the signal obtained after sampling? If the signal is sampled at the rate of 75Hz, what is the reconstructed analog signal? (8)

(OR)

    b) (i) Determine whether the following signals are periodic. If yes, find the fundamental period. x(t) = 3cos(5t + π/6); x(n) = cos(n/8).cos(πn/8) (6)

    (ii) Explain how a signal is quantized and derive the signal-to-quantization noise ratio. (8)

22. a) (i) A LTI system is characterized by the system function: (8)

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Determine the impulse response if the system is : causal, stable.

(ii) Find the frequency response of the above system. Does it exist? Justify the answer. (6)

(OR)

b) (i) Determine the convolution of the given signals using z-transform: (12)
$x_1(n) = (1/4)^n u(n-1)$, $x_2(n) = [1 + (1/2)^n]u(n)$

(ii) Sketch the pole-zero plot for the above transforms and indicate the ROC. (2)

23. a) (i) Compute the 8-point DFT of the given sequence using radix-2 DIT algorithm. Indicate the results using butterfly diagram. (10)
x[n] = {½, ½, ½, ½, 0, 0, 0, 0}

(ii) Compute the circular convolution of the given two sequences: (4)
$x_1(n) = \{1, 2, 2, 1\}$, $x_2(n) = \{1, 2, 3, 4\}$

(OR)

b) (i) Explain the radix-2 DIF FFT algorithm with a flow diagram. (10)

(ii) With an example, illustrate the circular symmetries of a sequence. (4)

24. a) (i) The desired frequency response of a low pass filter is given by: (10)

$$H_d(e^{j\omega}) = e^{-j2\omega}, \quad -\frac{\pi}{4} \leq \omega \leq \frac{\pi}{4}$$
$$= 0, \quad \frac{\pi}{4} < |\omega| \leq \pi$$

Design the filter using rectangular window of length 5.

(ii) Compare Butterworth and Chebyshev filters. (4)

(OR)

b) Obtain the direct form I, direct form II, cascade and parallel structures for the following system: (14)

$$H(z) = \frac{2(1 - z^{-1})(1 + \sqrt{2}z^{-1} + z^{-2})}{(1 + 0.5z^{-1})(1 - 0.9z^{-1} + 0.81z^{-2})}$$

25. a) (i) Explain the bus architecture of TMS320C54XX processor. (8)

(ii) What are the salient features of MATLAB? (6)

(OR)

b) (i) Describe any four special addressing modes of TMS320C54XX. (8)

(ii) Illustrate how linear convolution can be implemented using MATLAB. Explain with an algorithm. (6)

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