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Question Paper Code : 31368

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fifth Semester

Electrical and Electronics Engineering

EC 2361/EC 2314/EC 65/10144 EC 502/10133 EE 502 — DIGITAL SIGNAL PROCESSING

(Common to Electronics and Instrumentation Engineering and Instrumentation and Control Engineering)

(Regulation 2008/2010)

(Also common to PTEC 2361 – Digital Signal Processing for B.E (Part-Time) Fifth Semester Electronics and Instrumentation Engineering – Regulation 2009)

Time : Three hours　　　　　　　　　　　　Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is the Nyquist rate for the signal $x_a(t) = 3\cos 600\pi t + 2\cos 1800\pi t$?

2. Determine the fundamental period of the signal $\cos\left(\frac{\pi 30n}{105}\right)$.

3. Determine the z-transform and ROC for the signal $x(n) = \delta(n-k) + \delta(n+k)$.

4. Prove the convolution property of z-transform.

5. Draw the butterfly diagram for decimation in time FFT algorithm.

6. In eight point decimation in time (DIT), what is the gain of the signal path that goes from $x(7)$ to $X(2)$?

7. Is the given transfer function $H(z)=\frac{1+0.8z^{-1}}{1-0.9z^{-1}}$ represents low pass filter or high pass filter?

8. The impulse response of an analog filter is given in figure 1. Let $h(n) = h_a(nT)$ where $T = 1$. Determine the system function.

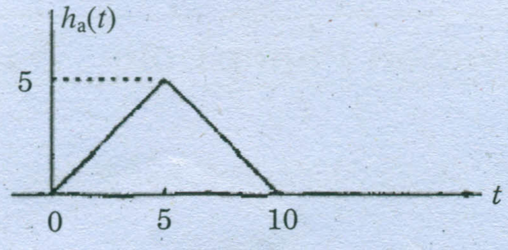

Figure 1

9. What is meant by bit reversed addressing mode? What is the application for which this addressing mode is preferred?

10. Compare the RISC and CISC processors.

PART B — (5 × 16 = 80 marks)

11. (a) Determine the response of the following systems to the input signal

$$x(n) = \begin{cases} |n|, & -3 \le n \le 3 \\ 0, & \text{otherwise} \end{cases}$$

(i) $x_1(n) = x(n-2)\,\delta(n-3)$

(ii) $x_2(n) = x(n+1)\,u(n-1)$

(iii) $y(n) = \frac{1}{3}[x(n+1) + x(n) + x(n-1)]$

(iv) $y(n) = \max[x(n+1), x(n), x(n-1)]$

(v) Find the even and odd components of given $x(n)$. (16)

Or

(b) A discrete time systems can be

(i) Static or dynamic

(ii) Linear or non linear

(iii) Time invariant or time varying

(iv) Stable or unstable.

Examine the following system with respect to the properties above $y(n) = x(n) + nx(n+1)$. (16)

12. (a) (i) Determine the causal signal $x(n)$ whose z-transform is given by

$$X(z) = \frac{1+z^{-1}}{1-z^{-1}+0.5z^{-2}}.$$ (10)

(ii) Determine the z-transform of the signal $x(n) = (\cos \omega_0 n)u(n)$. (6)

Or

(b) Consider the system shown in figure 2 with $h(n) = a^n u(n)$, $-1 < a < 1$. Determine the response $y(n)$ of the system to the excitation $x(n) = u(n+5) - u(n-10)$. (16)

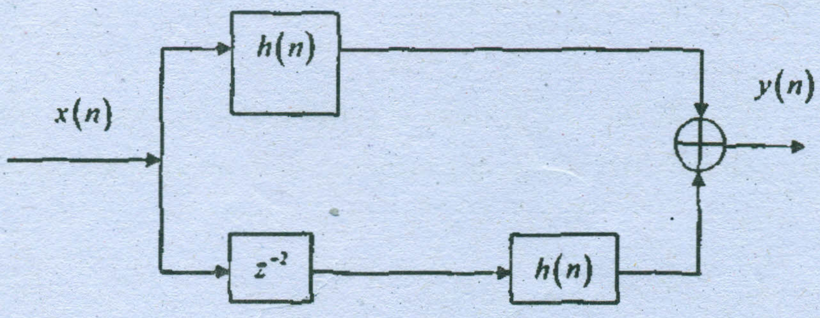

Figure 2

13. (a) (i) The first five points of the eight point DFT of a real valued sequence are $\{0.25, 0.125 - j0.3018, 0, 0.125 - j0.0518, 0\}$. Determine the remaining three points. (4)

(ii) Compute the eight point DFT of the sequence $x = [1,1,1,1,1,1,1,1]$, using Decimation-in-Frequency FFT algorithm. (12)

Or

(b) Consider the sequences :

$x_1(n) = \{0,1,2,3,4\}, x_2(n) = \{0,1,0,0,0\}$

$s(n) = \{1,0,0,0,0\}$

(i) Determine a sequence $y(n)$ so that $Y(k) = X_1(k)X_2(k)$

(ii) Is there a sequence $x_3(n)$ such that $S(k) = X_1(k)X_3(k)$?

14. (a) Design an FIR linear phase, digital filter approximating the ideal frequency response $H_d(\omega) = \begin{cases} 1, & |\omega| \le \frac{\pi}{6} \\ 0, & \frac{\pi}{6} < |\omega| \le \pi \end{cases}$.

Determine the coefficients of a 25 tap filter based on the window method with a rectangular window. (16)

Or

(b) (i) Convert the analog filter with system function $H_a(s) = \frac{s + 0.1}{(s + 0.1)^2 + 9}$ into a digital IIR Filter by means of the impulse invariance method. (8)

(ii) Draw the direct form I and direct form II structures for the given difference equation $y(n) = y(n-1) - 0.5y(n-2) + x(n) - x(n-1) + x(n+2)$. (8)

15. (a) Explain Von Neumann, Harvard architecture and modified Harvard architecture for the computer. (16)

Or

(b) (i) Explain how convolution is performed using a single MAC unit. (8)

(ii) Discuss the addressing modes used in programmable DSPs. (8)