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Question Paper Code : 71039

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Electrical and Electronics Engineering

EC 65 – DIGITAL SIGNAL PROCESSING

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

(Regulations 2008)

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

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Given a continuous time signal $x(t) = 2 \cos 500 \pi l$. What is the Nyquist rate and fundamental frequency of the signal ?
2. Determine whether $x[n] = u[n]$ is a power signal or an energy signal.
3. What is the Z transform of $x(n) = \delta(n) - 0.95\, \delta(n-1)$?
4. State the convolution property of Z transform.
5. Draw the butterfly diagram for decimation in time FFT algorithm.
6. What is the relationship between DFT and Z transform ?
7. Define pre-warping effect. Why is it employed ?
8. Give Hamming window function.
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) Compute the convolution for the signals **(16)**

$x(n) = \alpha^n, \; -3 \le n \le 5$

$\quad\quad 0, \;$ elsewhere

$h(n) = 1, \; 0 \le n \le 4$

$\quad\quad 0, \;$ elsewhere

OR

(b) Consider the analog signal

$x_a(t) = 3 \cos 2000\, \pi t + 5 \sin 6000\, \pi t = 10 \cos 12{,}000\, \pi t$

(i) What is the Nyquist rate for this signal ? **(4)**

(ii) Assume now that we sample this signal using a sampling rate $F_S = 5000$ samples/sec. What is the discrete time signal obtained after sampling ? **(6)**

(iii) What is the analog signal $y_a(t)$ that we can reconstruct from the samples if we use ideal interpolation. **(6)**

12. (a) (i) Find the Z-transform and its associated ROC for the following discrete time signal $x[n] = \left(\frac{-1}{5}\right)^n u[n] + 5\left(\frac{1}{2}\right)^{-n} u[n-1]$. **(8)**

(ii) Evaluate the frequency response of the system described by system function $H(z) = \frac{1}{1 - 0.5z^{-1}}$. **(8)**

OR

(b) Using z-transform determine the response y[n] for $n \ge 0$ if

$y[n] = \frac{1}{2} y[n-1] + x[n], \; x[n] = \left(\frac{1}{3}\right)^n u(n) \; y(-1) = 1.$ **(16)**

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 $Y(k) = X_1(k)\, X_2(k)$. **(8)**

(ii) Is there a sequence $x_3(n)$ such that $S(k) = X_1(k)\, X_3(k)$? **(8)**

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 $y(n) = y(n-1) - 0.5\, y(n-2) + x(n) - x(n-1) + x(n+2)$. **(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)**
