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Question Paper Code : 57318

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

Fourth Semester

Electrical and Electronics Engineering

EE 6403 – DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING

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

(Regulations 2013)

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

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Determine if the system described by the equation $y(n) = x(n) + \frac{1}{x(n-1)}$ is causal or non-causal.

2. What is an Anti-Aliasing filter ?

3. Determine the Z-transform and ROC of the following finite duration signals

   (i) $x(n) = \{3, 2, 2, 3, 5, 0, 1\}$

   (ii) $x(n) = \delta(n - k)$

4. Compute the convolution of the two sequences

   $x(n) = \{2, 1, 0, 0.5\}$ and $n(n) = \{2, 2, 1, 1\}$

5. Draw the flow graph of a 4 point radix-2 DIT-FFT butterfly structure for DFT.

6. What are the applications of FFT algorithm ?

7. Obtain the cascade realization for the system function,

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

8. Mention the advantages of FIR filters over IIR filters.

9. What are the merits and demerits of VLIW architecture ?

10. What are the factors that influence the selection of DSP processor for an application ?

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Determine if the signals, $x_1(n)$ and $x_2(n)$ are power, energy or neither energy nor power signals.

$x_1(n) = \left(\frac{1}{3}\right)^n u(n)$ and $x_2(n) = e^{2n} u(n)$. **(8)**

(ii) What is the input signal $x(n)$ that will generate the output sequence $y(n) = \{1, 5, 10, 11, 8, 4, 1\}$ for a system with impulse response $h(n) = \{1, 2, 1\}$. **(8)**

OR

(b) (i) A signal $x(t) = \sin c(50 \pi t)$ is sampled at a rate of (1) 20 Hz (2) 50 Hz and (3) 75 Hz. For each of these cases, explain if you can recover the signal $x(t)$ from the samples signal. **(6)**

(ii) Determine whether or not each of the following signals is periodic. If the signal is periodic, specify its fundamental period.

(1) $x(n) = e^{j6\pi n}$ **(5)**

(2) $x(n) = \cos\frac{\pi}{3}n + \cos\frac{3\pi}{4}n$. **(5)**

12. (a) (i) Find $x(n)$ if $X(z) = \dfrac{1 + \frac{1}{2}z^{-1}}{1 - \frac{1}{2}z^{-1}}$ **(6)**

(ii) Find the response of the causal system $y(n) - y(n-1) = x(n) + x(n-1)$ to the input $x(n) = u(n)$. Test its stability. **(10)**

OR

(b) Find the impulse response, frequency response, magnitude response and phase response of the second order system.

$$y(n) - y(n-1) + \frac{3}{16}y(n-2) = x(n) - \frac{1}{2}x(n-1).$$ **(16)**

13. (a) (i) Summarize the steps of radix – 2 DIT-FFT algorithm. **(8)**

(ii) Compute the 4 point DFT of the sequence $x(n) = \{0, 1, 2, 3\}$ using DIT and DIF algorithm. **(8)**

OR

(b) Find the IDFT of the sequence

$X(K) = \{4, 1 - j\,2.414, 0, 1 - j\,0.414, 0, 1 + j\,0.414, 0, 1 + j\,2.414\}$

Using DIF algorithm. **(16)**

14. (a) Design an ideal low pass filter with a frequency response

$$H_d(e^{jw}) = 1 \text{ for } \frac{-\pi}{2} \le w \le \frac{\pi}{2}$$

$$= 0 \text{ for } \frac{\pi}{2} \le |w| \le \pi$$

Find the values of $h(n)$ for $N = 11$. Find $H(z)$ and the filter coefficients. **(16)**

OR

(b) (i) Given the specifications $\alpha_p = 3$ dB, $\alpha_s = 10$ dB, $f_p = 1$ kHz and $f_s = 2$ kHz. Determine the order of the filter using Chebyshev approximation. Find $H(s)$. **(8)**

(ii) Apply bilinear transformation to

$H(s) = \dfrac{2}{(s+1)(s+2)}$ with $T = 1$ sec and find $H(z)$. **(8)**

15. (a) (i) Discuss on the addressing modes supported by a DSP processor. (8)

(ii) Design a DSP based system for the process of Audio signals in an audio recorder system. (8)

OR

(b) (i) Explain the datapath architecture and the bus structure in a DSP processor with suitable diagram. (8)

(ii) Elaborate on Radar signal processing using a DSP processor. (8)