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Question Paper Code : 70474

B.E./ B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

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-casual.

2. What is an Anti-Aliasing filter?

3. Write the properties of region of convergence?

4. Find the convolution of the input signal {1, 2, 1 } and its impulse response {1, 1, 1 } using Z transform.

5. Calculate the percentage saving in calculation in a 256 point radix-2 FFT when Compared to direct FFT.

6. State circular frequency shift property of DFT.

7. Why are digital filters more useful than analog filters?

8. Name one method that convert the transfer function of a analog into the digital filter.

9. How do a digital signal processor differ from other processors.

10. State any two application of DSP.

PART B — (5 × 13 = 65 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 $x_2(n) = e^{2n}u(n)$. (7)

(ii) What is the input $x(n)$ that will generate an output sequence $y(n) = \{1, 5, 10, 11, 8, 4, 1\}$ for a system with impulse response $h(n) = \{1, 2, 1\}$. (6)

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. (5)

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

(1) $x(n) = e^{j6\pi n}$ (4)

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

12. (a) (i) Explain the role of windowing to realize a FIR filter.

(ii) Compare and explain on the choice and type of windows selection for signal analysis.

(iii) Compute numerically the effect of Hamming windows and design the filter if

Cut-off frequency = 100 Hz. (5+5+3)

Sampling frequency = 1000 Hz.

Order of filter = 2

Filter length required = 5.

Or

(b) Evaluate the following :

(i) The impulse response $h(n)$ for $y(n) = x(n) + 2x(n-1) - 4x(n-2) + x(n-3)$

(ii) The ROC of a finite duration signal $x(n) = \{2, -1, -2, -3, 0, -1\}$

(iii) Inverse Z-Transform for $X(z) = 1/(z - 1.5;)^4$; $ROC : |z| > 1/4$.

13. (a) (i) Determine the DFT of the sequence $x(n) = \begin{cases} \frac{1}{4}, & for\ 0 \le n \le 2 \\ 0, & otherwise \end{cases}$ (7)

(ii) Draw the flow graph of an 8-point DIF - FFT algorithm and explain. (6)

Or

(b) (i) Given $x(n) = n + 1$, and $N = 8$, find $X(K)$ using DIT, FFT algorithm. (7)

(ii) Use 4 - point inverse FFT for the DFT result $\{6, -2 + j2, -2, -2 - j2\}$ and determine the input sequence. (6)

14. (a) Design a digital Butterworth filter using the Impulse invariance method for the following specifications: (13)

$$0.8 \le \left|H(e^{j\omega})\right| \le 1 \ ; \ 0 \le \omega \le 0.2\pi$$
$$\left|H(e^{j\omega})\right| \le 0.2 \quad ; \ 0.6\pi \le \omega \le \pi.$$

Or

(b) Design a filter with desired frequency response

$$H_d(e^{j\omega}) = e^{-j3\omega} \ ; \ \frac{-3\pi}{4} \omega \le \frac{3\pi}{4}$$
$$= 0 \quad ; \ \frac{3\pi}{4} \le \omega \le \pi.$$

Using a Hanning window for N = 7. (13)

15. (a) Discuss the features and architecture of TMS 320C50 processor. (13)

Or

(b) Explain the addressing modes and registers of DSP processors. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Design an ideal bandpass filter with a frequency response $H_d(e^{jw}) = \begin{cases} 1 & for\ \frac{\pi}{4} \le |w| \le \frac{3\pi}{4} \\ 0 & otherwise \end{cases}$ find the values of h(n) for N=11 and plot the frequency response. (15)

Or

(b) Compute the response of the system

$$y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-1) + x(n-2)$$

to input $x(n) = nu(n)$. Is the system stable? (15)
