Reg. No. :

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B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Fourth Semester

Electrical and Electronics Engineering

EE 6403 — DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING

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

(Regulation 2013)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Check if the system described by the difference equation $y(n) = ay(n-1) + x(n)$ with $y(0) = 1$ is stable.
2. Differentiate between Energy and Power singals.
3. Determine the Z-transform of $x(n) = a^n$.
4. Find the DFT of the sequence $x(n) = \{1,1,0,0\}$.
5. Determine the Fourier Transform of the signal $x(t) = \sin w_0 t$.
6. Draw the basic butterfly flow graph for the computation in the DIT FFT Algorithm.
7. Comment on the passband and stop band characteristics of butter worth filter.
8. Realize the following causal linear phase FIR system function $H(z) = \frac{2}{3} + z^{-1} + \frac{2}{3}z^{-2}$.
9. How do a digital signal processor differ from other processors.
10. State any two application of DSP.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the impulse response of a discrete time invariant system whose difference equation is given by
$y(n) = y(n-1) + 0.5y(n-2) + x(n) + x(n-1)$. (12)

(ii) Explain the properties of discrete time system. (4)

Or

(b) (i) A discrete time system is represented by the following difference equation in which $x(n)$ is input and $y(n)$ is output

$y(n) = 3y(n-1) - nx(n) + 4x(n-1) + 2x(n+1)$; and $n \geq 0$. Is this system linear? Shift invariant? Causal? In each case, justify your answer. (12)

(ii) What is meant by quantization and quantization error? (4)

12. (a) (i) Find the Z transform of $x(n) = n^2 u(n)$. (8)

(ii) Find the inverse $Z-$transform of $X(Z) = \dfrac{Z}{3Z^2 - 4Z + 1}$ for Region of convergence (1) $|Z| > 1$, (2) $|Z| < \dfrac{1}{3}$ (3) $\dfrac{1}{3} < |Z| < 1$. (8)

Or

(b) (i) Convolute the following two sequences $x_1(n) = \{0,1,4,-2\}$ and $x_2(n) = \{1,2,2,2\}$. (8)

(ii) Find the frequency response of the LTI system governed by the equation $y(n) = a_1 y(n-1) - a_2 y(n-2) - x(n)$. (8)

13. (a) (i) Determine the DFT of the sequence $x(n) = \begin{cases} \dfrac{1}{4}, & \text{for } 0 \leq n \leq 2 \\ 0, & \text{otherwise} \end{cases}$. (8)

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

Or

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

(ii) Use 4 – point inverse FFT for the DFT result $\{6, -2 + j2, -2, -2 - j2\}$ and determine the input sequence. (8)

14. (a) A low pass filter is to be designed with the following desired frequency response. $H_d(e^{jw}) = \begin{cases} e^{-j2w}, & \dfrac{-\pi}{4} \leq |w| \leq \dfrac{\pi}{4} \\ 0, & \dfrac{\pi}{4} < |\omega| \leq \pi \end{cases}$.

Determine the filter coefficients $h_d(n)$ if the window function is defined as $\omega(n) = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0, & \text{otherwise} \end{cases}$. (16)

Or

(b) Determine $H(z)$ for a Butter worth filter satisfying the following constraints.

$$\sqrt{0.5} \leq \left|H(e^{jw})\right| \leq 1 \; ; \; 0 \leq w \leq \frac{\pi}{2}$$

$$\left|H(e^{jw})\right| \leq 0.2 \; ; \frac{3\pi}{4} \leq w \leq \pi$$

with $T = 1$ s. Apply impulse invariant transformation. (16)

15. (a) Draw the architecture of a DSP processor for implementing a DSP algorithm. Explain its features. (16)

Or

(b) (i) Name the different addressing modes of a DSP processor. Explain them with an example. (10)

(ii) Write a note on commercial DSP processor. (6)