Register Number: ……..

B.E DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Sixth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

EIE112: Digital Signal Processing

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Nyquist rate is defined as_____
   A. $f_s = 2f_m$ B. $f_s < 2f_m$
   C. $f_s > 2f_m$ D. $f_s = f_m$
2. The system $y[n] = x^2[n]$ is_____
   A. Linear system B. Non-Linear system
   C. Time variant system D. Recursive system
3. y[n] =x[n]*h[n] is equivalent to
   A. $Y(Z) = X(Z)H(Z)$ B. $Y(Z) = X(Z)H(Z^{-1})$
   C. $Y(Z) = X(Z^{-1})H(Z)$ D. $Y(Z) = X(Z)/H(Z)$
4. The transfer function of difference equation y[n]-y[n-1] = x[n] is
   A. $1/(1-Z^{-1})$ B. $1/(1-Z)$
   C. $1/(1+Z^{-1})$ D. $1/(Z^{-1}-1)$
5. Circular convolution of two sequences $x_1[n]$ and $x_2[n]$ is equivalent to
   A. $X_1[K]X_2[K]$ B. $X_1[K]/X_2[K]$
   C. $X_1[K]*X_2[K]$ D. $X_1[K]X_2[N-1]$
6. The number of multiplications required in radix-2 FFT calculations
   A. $N \log_2(N/2)$ B. $N \log_2 N$
   C. $N/2 \log_2 N$ D. $N/2 \log_2(N/2)$
7. The following Windowing technique has better frequency response
   A. Hanning Window B. Rectangular Window
   C. Hamming Window D. Triangular Window
8. Linear Phase response is achieved in FIR filter of length 'M'when the impulse response h[n]=_____
   A. $h[n] = \pm h[M-n]$ B. $h[n] = h[M]$
   C. $h[n] = \pm h[M-1]$ D. $h[n] = \pm h[M-1-n]$

9. Compared to ordinary processor DSP processor has the advantage of_____
   A. Numerical computation B. Math operations
   C. Pipelining operations D. Scientific calculations
10. The in-built function is used to find 2D Inverse Discrete Fourier Transform in MATLAB is
   A. fft2() B. ifft2()
   C. fft() D. dft()

PART B (10 x 2 = 20 Marks)

11. Mention the classification of system.
12. Find the fundamental period of the sinusoid $\cos(0.01\pi n)$.
13. Give the shifting property and scaling property of z-transform.
14. Express the discrete signal $x[n] = (0.3)^n$ in z-domain.
15. Give the analysis and synthesis equations for DFT.
16. Find the Discrete Fourier Transform for the sequence $x[n] = \{0,1\}$.
17. Mention the advantages of FIR filters.
18. Mention any two properties of butterworth filter.
19. Give the two important features of TMS320C54XX DSP processor.
20. Write a MATLAB program to find linear convolution of two sequences x[n] and h[n].

PART C (5 x 14 = 70 Marks)

21. a) (i) Check whether the following systems are causal(or) not: (9)
   (1) $y[n] = 3x[n-2]+3x[n+2]$ (2) $y[n]=x[n-1]+ax[n-2]$ (3) $y[n]=x[-n]$
   (ii) Determine the average power and energy of the unit sample sequence. (5)

(OR)

   b) Consider the analog signal $x_a(t) = 3\cos(100\pi t)$
   (i) Determine the minimum sampling rate required to avoid aliasing (2)
   (ii) Suppose that the signal is sampled at a rate of f_s = 200 Hz, what is the discrete time signal obtained after sampling? (4)
   (iii) Suppose that the signal is sampled at the rate f_s = 75Hz, what is the discrete time signal obtained after sampling? (4)
   (iv) What is the frequency of a sinusoid that leads samples identical to those obtained in part (3)? (4)

22. a) Determine the response of the system, whose linear constant coefficient

difference equation is given by,

$y[n]-0.1\ y[n-1]-0.12y[n-2] = x[n]-0.4\ x[n-1]$

if $y[-1] = y[-2] = 2$ and $x[n]=(0.4)^n u[n]$.

(OR)

b) (i) Determine the z-transform of the signal $x[n] = -a^n u[-n-1]-b^n u[-n-1]$, $b>a$ and find the ROC. (8)

(ii) Derive the relationship between Z-transform and Discrete Time Fourier Transform (DTFT). (6)

23. a) (i) Compute the 4 point DFT for the discrete sequence $x[n] = \{0,-1,2,3\}$ (6)

(ii) Prove that $\sum_{n=0}^{N-1}|x[n]|^2 = \left(\frac{1}{N}\right)\sum_{k=0}^{N-1}|X(k)|^2$, where $|X(k)|$ is the DFT of $x[n]$. (8)

(OR)

b) Compute the DFT of the following sequence

$$x[n]=\begin{cases}0, & 0\le n\le 2\\ 1, & 3\le n\le 6\\ 0, & 7\end{cases}$$. Find the magnitude spectrum.

24. a) Design a nine tap FIR band stop filter having the ideal response

$$H_d(\omega)=\begin{cases}1, |\omega|\le\frac{\pi}{6}\\ 0, \frac{\pi}{6}<|\omega|\le\frac{\pi}{3}\\ 1, \frac{\pi}{3}<|\omega|\le\pi\end{cases}$$. Use Hamming Window.

(OR)

b) Design a digital Butterworth filter that satisfies the following constraint using bilinear transformation T = 1 sec.

$$0.9\le|H(e^{j\omega})|\le 1, \quad 0\le\omega\le\frac{\pi}{2}$$

$$|H(e^{j\omega})|\le 0.2, \frac{3\pi}{4}\le\omega\le\pi$$

25. a) Draw the architecture of TMS320C54XX and explain its features.

(OR)

b) (i) Write a MATLAB program to find circular convolution of two sequences. (7)

(ii) Write a MATLAB program to find the DFT of the following sequences: (7)
$x[n] = \{1,2,3,4,4,3,2,1\}$ using fft() inbuilt function and plot its magnitude spectrum.

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