Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination
March/ April, 2017

Level : B. E.
Year : IV
Course : COMP 407
Semester : I
Exam Roll No. :
Time: 30 mins.
F. M. : 10
Registration No.:
Date : APR 16 2017

SECTION "A"
[20 Q × 0.5 = 10 marks]

Select the most appropriate option.

1. In general, How is Signal Energy defined mathematically?
   a. $E_f = \int_0^{\infty} f(t)dt$
   b. $E_f = \int_{-\infty}^{\infty} f^2(t)dt$
   b. $E_f = {}^1/_T \int_{-\infty}^{0} f^2(t)dt$
   d. $E_f = {}^1/_T \int_{-T}^{T} f^2(t)dt$

2. The fundamental period of signal $x(t) = sin(20\pi t)$ is
   a. 0.1 sec
   b. 0.2 sec
   c. 0.1 Hz
   d. 0.2 Hz

3. The function $f(x) = x^2 + 4$ is
   a. DC signal
   b. Random Signal
   c. Even Signal
   d. Odd signal

4. What is the product of two even functions?
   a. Even function
   b. Odd function
   c. Random Function
   d. Deterministic Function

5. While combined signal operation, if α is positive in $x[\alpha(t + \beta/\alpha)]$ then
   a. Signal is reversed
   b. Signal is left shifted by α
   c. Signal is right shifted by α
   d. Signal is not flipped.

6. For the system with input output relationship $y[k] = 2x[k-3]$, the impulse response is:
   a. $3\delta[k-2]$
   b. $2\delta[k-2]$
   c. $2\delta[k-3]$
   d. $3\delta[k-1]$

7. If $x[n] = 2\,\delta[n] + 2\delta[n-3]$ then $x[n-1]$ is .....
   a. $2\delta[n] + \delta[n-4]$
   b. $\delta[n-1] + \delta[n-3]$
   c. $\delta[n] + 2\delta[n-4]$
   d. $2\delta[n-1] + 2\delta[n-4]$

8. If the analog signal $x(t) = 2cos(4000\pi t)$ is sampled at the rate of F_s=5000 Hz. The discrete time signal obtained after sampling is
   a. $2\cos(40\pi n)$
   b. $2\cos(\frac{4\pi n}{5})$
   c. $4\cos(\pi n)$
   d. $4\cos(\frac{\pi n}{5})$

9. The expression for impulse train is
   a. $s(t) = \sum_{n=-\infty}^{n=0} \delta(t-n)$
   b. $s(t) = \sum_{n=-\infty}^{n=\infty} \delta(t-n)$
   c. $s(t) = \sum_{n=-\infty}^{n=\infty} \delta(t-nt)$
   d. $s(t) = \sum_{n=0}^{n=\infty} \delta(t-nt)$

10. If f_s is samping frequency and f_n is highest frequency of the signal then for perfect reconstruction of signal, the minimum value of sampling frequency must be
a. f_n b. $f_n/2$ c. $2f_s$ d. $2f_n$

11. Which of the following relations are true if $x(n)$ is real?
a. $X(\omega) = X(-\omega)$ b. $X(\omega) = -X(-\omega)$
c. $X^*(\omega) = X(\omega)$ d. $X^*(\omega) = X(-\omega)$

12. If $X(\omega)$ is the Fourier transform of the signal $x(n)$, then what is the Fourier transform of the signal $x(n-k)$?
a. $e^{j\omega k}.X(-\omega)$ b. $e^{j\omega k}.X(\omega)$ c. $e^{-j\omega k}X(-\omega)$ d. $e^{-j\omega k}.X(\omega)$

13. The value of twiddle factor W_8^8 is
a. 0 b. –j c. j d. 1

14. The value of twiddle factor W_4^1 is
a. 0 b. –j c. j d. 1

15. The total number of complex multiplication required for N point FFT is
a. N^2 b. $\frac{N}{2} * log_2 N$ c. $4\,N^2$ d. $N * log_2 N$

16. The ROC of signal $X[z] = 2z^3 + 2z^2 + 2z + 2z^{-1}$ is
a. Entire Z plane.
b. Entire Z plane except z= 0.
c. Entire Z plane except z=∞.
d. Entire Z plane except z=0 and z=∞.

17. Which of the following is not the method for implementing an FIR system?
a. Direct form b. Lattice structure c. Window Structure d. Cascade form

18. In ideal case, attenuation in pass band is
a. 0 b. 1 c. ∞ d. -∞

19. Type-1 Chebyshev filter have
a. ripples in pass band b. ripples in stop band
c. linear phase d. no ripples in pass band

20. For FIR filter design, the window which allows separate control of width of the main lobe and attenuation of side lobe is
a. Kaiser Window b. Rectangular Window
c. Hamming Window d. Blackman Window

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SECTION "B"
[5Q × 8 = 40 marks]

Attempt *ANY FIVE* questions.

1. a. Draw the signal $x[n] = 2\delta[n+2] + \delta[n] + \delta[n-1] + 2\delta[n-2]$ in graph and find [1+(1×3)=4]
   i. $x[2-n]$.
   ii. $x[2+n]$.
   iii. $2\,x[n]$.
   b. Discuss the following terms in detail: [2×2=4]
   i. Causal & Non-Causal Signal.
   ii. Combined Signal Operation.

2. a. Determine the causality, linearity, and time invariance of $y[n] = (sin\pi n)x[n]$. [1×3=3]
   b. Explain Nyquist Sampling Theorem and condition of aliasing with suitable diagram. [2]
   c. State and prove the frequency shifting properties of DTFT. [3]

3. a. What's the basic difference between Linear Convolution and Circular Convolution? Compute the 4 point circular convolution of following sequences using circular graph.[3]
   $x[n] = \{1,2,3,4\}$ & $h[n] = \{1,3,5,7\}$
   b. Use the butterfly diagram to compute 8-point DIT-FFT of the following sequence using radix-2 decimation in time algorithm, $x(n) = \{½, ½, ½, ½, 0,0,0,0\}$. [5]

4. a. Find the Fourier transform of Impulse train. [3]
   b. Find the inverse Z-transform of $H(z) = \frac{z(z+3)}{z^2-3z+2}$, ROC 1<|z|<2. [3]
   c. Realize the IIR system with the system function H(z) given below using Direct Form II structure. [2]
   $$H(z) = \frac{1+0.56z^{-1}+0.8z^{-2}+0.08z^{-3}}{1+0.6z^{-1}+0.3z^{-2}-0.4z^{-3}}$$

5. a. Discuss the different interconnection of discrete time system. [2]
   b. Derive how analog system function $H_a(s)$ is transformed to Digital System Function $H(z)$ and find the final relation between analog frequency and digital frequency in impulse invariant method. [4]
   c. Discuss Butterworth Filter Approximations with the help of suitable diagram. [2]

6. a. A low pass filter is desired to have frequency response $H_d()$ as defined below. Design FIR filter using Hamming window to meet the following requirement, if the cut-off frequency $_c = \frac{\pi}{3}$, and order $N = 5$. Does this filter have linear phase? [4]

$$H_d() = \begin{cases} e^{-j\left(\frac{N-1}{2}\right)} ; & 0\leq| |\leq_c \\ 0; & otherwise \end{cases}.$$

The Hamming Window is defined as,

$$W[n] = \begin{cases} 0.54 - 0.46cos\frac{2\pi n}{N-1}, & 0 \leq n \leq N-1 \\ 0, & otherwise \end{cases}.$$

   b. Discuss the following terms. [2 × 2 = 4]
   i. Frequency warping ii. Gibbs Phenomena.