Mark Scored:

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Level : B. E.
Year : IV

Course : COMP 407
Semester: I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : FEB 2 4 2019

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Select the most appropriate option.

1. The product of two odd functions is an
   a. Even function
   b. Odd function.
   c. Random Function
   d. Deterministic Function

2. The power average of signal $x(t) = 2\sin(t)$ is
   a. 2 b. 4 c. ∞ d. 0

3. The energy of signal $x(t) = 2\sin(t)$ is
   a. 2 b. 4 c. ∞ d. 0

4. The signals $x[-8-2k]$ can be obtained from $x[k]$ by
   a. Compressing the signal by 2, reversing the signal then shifting the signal right by 4 units.
   b. Expanding the signal by 2, reversing the signal then shifting the signal left by 4 units.
   c. Expanding the signal by 2, reversing the signal then shifting the signal right by 4 units.
   d. Compressing the signal by 2, reversing the signal then shifting the signal left by 4 units.

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

6. The fundamental period of signal $x[n] = \cos[21\pi n]$ is
   a. 0.095 b. 10.5 c. 0.5 d. 5.15

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

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

9. If the analog signal $x(t) = cos(4000\pi t)$ is sampled at the rate of F_s =3000 Hz. The discrete time signal obtained after sampling is
   a. $\cos(3\pi n)$ b. $\cos(4\pi n)$ c. $\cos(4\pi n/3)$ d. $\cos(\pi n/3)$

10. In question number 9, to avoid aliasing sampling frequency must be
    a. $2001\ \pi$ b. $4001\ \pi$ c. $6001\ \pi$ d. $8001\ \pi$

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

12. The inverse Fourier transform
    a. converts the phasor domain to the magnitude domain
    b. converts the frequency domain to the time domain
    c. converts the time domain to the frequency domain
    d. is used to make real time spectrum analyzers

13. The fourier transform of delta function is
    a. 0 b. 1 c. ∞ d. Unit step signal

14. 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. $X(\omega) = -X(-\omega)$

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

16. The value of twiddle factor W_8^3 is
    a. $0.707 + j0.707$ b. $0.707 - j0.707$
    c. $-0.707 - j0.707$ d. $-0.707 + j0.707$.

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

18. The ROC of delta function is
    a. Entire Z plane except z= 0 b. Entire Z plane except z=∞.
    c. Entire Z plane except z= 0 and z=∞ d. Entire Z plane

19. If digital frequency $\omega_p = 0.2\pi$ and sampling time is 2 sec, then corresponding analog pass band frequency with reference to bilinear transformation is
    a. 0.735 b. 0.525 c. 0.325 d. 0.135

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

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SECTION "B"
[5Q. × 8 = 40 marks]

Attempt *ANY FIVE* questions.

1. a. Draw the signal $x[n] = \begin{cases} n^2 ; -3 \leq n \leq 2 \\ 0 ; \text{otherwise} \end{cases}$ in graph and find [1+(1×4)]
   i. $x[2-n]$.
   ii. x[3+n].
   iii. x[2n].
   iv. Energy & Power of the signal.

   b. Discuss the following terms in detail. [1.5×2=3]
   i. Stability of Linear time-invariant systems.
   ii. Time Variant and Invariant Systems.

2. a. For a LTI system, find the linear convolution between two signal x[n] and h[n], [2.5]
   where $x[n] = \begin{cases} 1; -1 \leq n \leq 2 \\ 0; \textit{elsewhere} \end{cases}$ & $h[n] = \begin{cases} 1; -1 \leq n \leq 1 \\ 0; \textit{elsewhere} \end{cases}$.
   b. Explain the use of periodic impulse train while sampling of signal. [2]
   c. State and prove the convolution property of DTFT. [3.5]

3. a. Find the Fourier transform of impulse train. [3]
   b. Compute the computation complexity of Discrete Fourier Transform and Fast Fourier Transform in detail. [3]
   c. Determine the 4-point DFT of the signal $x[n] = \{1,0,2,1\}$ [2]

4. a. Use the butterfly diagram to compute 8-point FFT of the following sequence using radix-2 decimation in frequency (DIF) algorithm, $x(n) = \{1,1,0,0,-1,-1,0,0\}$. [5]

   b. What do you understand by Region of Convergence (ROC) in Z-transform. Find the Z-transform and ROC of signal $x[n] = \begin{cases} -u[-n-1] \; for \; n \geq 0 \\ 0 \; for \; n < 0 \end{cases}$ [1+2]

5. a. What is the disadvantage of using long division method while obtaining inverse Z transform? Find the inverse Z-transform of $X(z) = \frac{1}{1-0.5z^{-1}+0.75z^{-2}}$ for ROC $|z| > 1$ using long division method. [0.5+2]
   b. If the coefficient of transfer function H(z) yields value for Lattice and Ladder structure as
   $k_1 = 1.25, k_2 = 1.45, k_3 = 1.6$ and $c_0 = 0.175, c_1 = 0.375, c_2 = 0.645, c_3 = 0.975$
   due to numerous operations like state variable representations, linear transformations and auto regressive modeling. Draw the appropriate filter structure from these values. [1.5]

c. Discuss the following terms in detail. [2 × 2=4]
   i. Low Pass Butterworth Filter Approximation.
   ii. Relationship between s plane and z plane in Impulse Invariance method.

6. a. Discuss the following terms. [2 × 2 = 4]
   i. Difference between Analog Filters and Digital Filters
   ii. Symmetric and Anti-symmetric FIR Filter.

   b. A low pass filter is desired to have frequency response $H_d(\omega)$ as defined below. Design FIR filter using Blackman window to meet the following requirement, if the cut-off frequency $w_c = \pi/3$, and order $N = 5$. Does this filter have linear phase? [4]

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

The Blackman Window is defined as,

$$W[n] = \begin{cases} 0.42 - 0.5cos\frac{2\pi n}{N-1} + 0.8\, cos\frac{4\pi n}{N-1}, & 0 \le n \le N-1 \\ 0, & otherwise \end{cases}.$$