KATHMANDU UNIVERSITY
End Semester Examinations
February/March, 2018

Marks Scored:

Level : B.E.
Year : IV

Course : COMP 407
Semester: I

Exam Roll No.:

Time: 30 mins

F.M. : 10

Registration No.:

Date : MAR 1 8 2018

SECTION "A"
[20 Q.×0.5=10 marks]

Select the most appropriate option.

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

2. The signals $x[-6-2k]$ can be obtained from $x[k]$ by
   a. Compressing the signal by 2, reversing the signal then shifting the signal right by 6 units.
   b. Expanding the signal by 2, reversing the signal then shifting the signal left by 6 units.
   c. Expanding the signal by 2, reversing the signal then shifting the signal right by 3 units.
   d. Compressing the signal by 2, reversing the signal then shifting the signal left by 3 units.

3. Which condition determines the causality of the LTI system in terms of its impulse response?
   a. Only if the value of an impulse response is zero for all negative values of time
   b. Only if the value of an impulse response is negative for all negative values of time
   c. Only if the value of an impulse response is infinity for all negative values of time
   d. Only if the value of an impulse response is unity for all negative values of time

4. Which of the following system is static system
   a. $y[k] = 2x[k] + 3$
   b. $y[k] = x[k-1]$
   c. $y[k] = 2x[k] + 3x[k-1]$
   d. $y[k] = 2x[k-1] + 3x[k-1]$

5. The fundamental period of signal $x(t) = sin(40\pi t)$ is
   a. 0.05 sec
   b. 0.5 sec
   c. 0.5 Hz
   d. 0.05 Hz

6. While combined signal operation, if α is negative 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.

7. The type of systems which are characterized by input and the output quantized at certain levels are called as
   a. Analog
   b. Discrete
   c. Continuous
   d. Digitals

8. A system which is linear is said to obey the rules of
   a. Scaling
   b. Additivity
   c. both Scaling and Additivity
   d. homogeneity

9. 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. $2\sin(\frac{4\pi n}{5})$.
   b. $2\cos(\frac{4\pi n}{5})$.
   c. $2\cos(\frac{2\pi n}{5})$.
   d. $4\cos(\frac{3\pi n}{5})$

10. If the analog signal $x(t) = 2cos(4000\pi t)$ is sampled at the rate of F_s=2000 Hz, then the Nyquist Rate is
   a. 2000π b. 4000π c. 6000π d. 8000π

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. The Fourier Transform of delta function is .....
   a. sinc function.
   b. rectangular function.
   c. two times exponential function.
   d. one.

13. The value of twiddle factor W_8^5 is
   a. 0.
   b. $0.707 - j0.707$.
   c. $-0.707 + j0.707$.
   d. 1.

14. The value of twiddle factor W_4^3 is
   a. j. b. 1. c. -1. d. -j.

15. The total number of complex multiplication required for 8 point DFT is
   a. 16 b. 32 c. 64 d. 128

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

17. If Ω is analog frequency, the maximum gain for Butterworth low pass filter occurs at
   a. Ω=0.
   b. Ω=1.
   c. Ω= cut-off frequency.
   d. Ω=∞.

18. IIR filter do not have
   a. Round off noise. b. Zeros System. c. Pole System. d. Linear phase.

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

20. Impulse Invariance method of IIR filer are ..... mapping, from s-domain to z- domain.
   a. one to one b. many to one c. many to many d. one to many

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SECTION "B"
[5Q.×8=40 marks]

Attempt any *FIVE* questions

1.a. Draw the signal $x[n] = 2\delta[n+2] + \delta[n] + \delta[n-1] + 2\delta[n-2] + \delta[n-4]$ in graph and find [1+(4×1)=5]
   i. $x[2-n]$.
   ii. $x[2+n]$.
   iii. $x[2n]$.
   iv. Energy & Power of the signal.

b. Discuss the following terms in detail. [2×1.5=3]
   i. Relationship between delta function and unit step signal.
   ii. Size of a signal

2.a. What do you understand by LTI System? Discuss some of the properties of LTI System? [1+2=3]

b. Explain the use of periodic impulse train while sampling of signal. [2]

c. State and prove the frequency shifting properties of DTFT. [3]

3.a. Find the Continuous Time Fourier transform of the signal $e^{jw_0 t}$. [2.5]

b. Compare the computation complexity of Discrete Fourier Transform and Fast Fourier Transform. [3]

c. Determine the 4-point DFT of the signal $x[n] = u[n] - u[n-3]$. [2.5]

4.a. Use the butterfly diagram to compute 8-point FFT of the following sequence using radix-2 decimation in time 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 $x[n] = \begin{cases} a^n \; for \; n \geq 0 \\ 0 \; for \; n < 0 \end{cases}$ [1+2]

5.a. What's the use of transfer function $H(z)$, while designing Digital Filter. Explain in detail, how Direct Form I and Direct Form II Structure is designed with the help of transfer function. [1+2]

b. Discuss the relationship of s-plane and z-plane for impulse invariant method in detail, with the help of its transfer function. [5]

6.a. Discuss the following terms. [2×1.5=3]

i. Low-pass Butterworth Filter Approximation.

ii. Finite Impulse Response filter design by windowing function.

b. A low pass filter is desired to have frequency response $H_d\,(w)$ as defined below. Design FIR filter using Hamming 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? [5]

$$H_d\,(w) = \begin{cases} e^{-j\left(\frac{N-1}{2}\right)w} \; ; \; 0 \le |w| \le w_c \\ 0; \qquad otherwise \end{cases}.$$

The Hamming Window is defined as,

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