KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Marks Scored:

Level : B.E.
Year : III
Course : EEEG 313
Semester : I
Exam Roll No. :
Time : 30 mins.
F. M. : 20
Registration No. :
Date FEB: 2 4 2019

SECTION "A"
[20 Q × 1 = 20 marks]

1. A signal $x(t) = sin\pi t + cos2\pi t$ is sampled at time intervals T. What is the limit for T such that aliasing does not occur?
a) $T > 0.5\ s$ b) $T = 0.5\ s$ c) $T < 0.5\ s$ d) $T > 4\pi\ s$

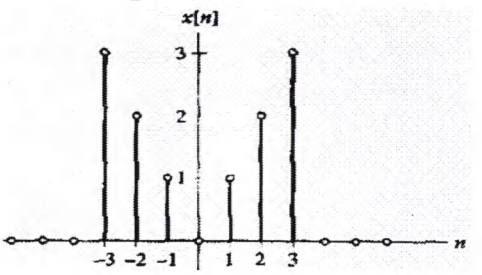
2. The signal $x(t) = t\,u(t)$ is called ……..
a) Shifted unit step signal
b) Scaled unit step signal
c) Ramp signal
d) Scaled unit impulse signal

3. Which is NOT the correct property of unit impulse signal (t) ?
a) $\int_{-\infty}^{\infty} 2\delta(t)dt = 2$
b) $\delta(-t) = -\delta(t)$
c) $\int_{-\infty}^{\infty} x(t)\delta(t)dt = x(0)$
d) $\delta(at) = \frac{1}{a}\delta(t)$

4. For a DT real exponential signal $x[n] = \beta\, r^n$ to be decaying and take only positive values, the condition/s that must be satisfied is:
a) $0 < r < 1$
b) $0 < |r| < 1$
c) $\beta = 1\ and\ 0 < |r| < 1$
d) $\beta = 1\ and\ |r| > 1$

5. The signal $x(t) = sint\ cost$ is a……signal.
a) neither odd nor even
b) odd or even
c) even
d) odd

6. The signal $x[n]$ is shown below. If $y[n] = x[-n-2]$, what is the value of $y[0]$?
a) 0
b) 1
c) 2
d) 3



7. If $x[n] = 0\ for\ 0 > n > 2$ and $y[n] = 0\ for - 1 > n > 3$ then for the signal $z[n] = x[n] * y[n]$, which of the following is correct?
a) $z[n] = 0\ \ for - 1 > n > 5$
b) $z[n] = 0\ for - 1 < n < 5$
c) $z[n] = 0\ for - 1 > n < 5$
d) $z[n] = 0\ for\ n > 5\ only$

8. An LTI system is BIBO stable only when the impulse response is absolutely summable. So, the LTI system with the impulse response $h[n] = 0.5^n u[n]$ is ……
a) is BIBO unstable
b) is BIBO stable
c) is conditionally stable
d) stability cannot be determined

9. A real CT signal $x(t)$ has the set of FS coefficients a_k. If the signal is scaled in time to obtain $x(2t)$ with set of FS coefficients b_k, which of following statement holds correct?

a) $b_k = 2a_k$ b) $b_k = \frac{1}{2}a_k$ c) $b_k = a_{2k}$ d) $b_k = a_k$

10. The Fourier transform of an unit impulse signal $\delta(t)$ is:

a) $X(j\omega) = \delta(\omega)$ b) $X(j\omega) = u(\omega)$
c) $X(j\omega) = 0$ d) $X(j\omega) = 1$

11. One of the major difference between CT Fourier series and DT Fourier series is that.....

a) CTFS spectrum is periodic while DTFS spectrum is aperiodic
b) DTFS spectrum is periodic while CTFS spectrum is aperiodic
c) DTFS spectrum is discrete while CTFS sprectrum is continuous
d) CTFS spectrum is discrete while DTFS sprectrum is continuous

12. If a_k and b_k represent the Fourier series coefficients of $x(t)$ and $x(-t)$, time reversal property of CTFS results.....

a) $b_k = -a_k$ b) $b_k = -a_k^*$ c) $b_k = a_{-k}$ d) $b_k = a_{-k}^*$

13. Fourier transform of a periodic signal $x(t) = cos\omega_0 t$ is.....

a) $\pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)]$ b) $\pi[\delta(\omega - \omega_0) - \delta(\omega + \omega_0)]$
c) $\pi\delta(\omega - \omega_0)$ d) $\pi\delta(\omega + \omega_0)$

14. Which of the following represents one of the DTFT properties?

a) $nx[n] \overset{FT}{\leftrightarrow} -j\frac{dX(e^{j\Omega})}{d\omega}$ b) $x[-n] \overset{FT}{\leftrightarrow} X(e^{-j\Omega})$

c) $x[n] - x[n-1] \overset{FT}{\leftrightarrow} (1 + e^{-j\Omega})\, X(e^{j\Omega})$ d) $x^*[n] \overset{FT}{\leftrightarrow} X(e^{-j\Omega})$

15. If a CT signal is given by $x(t) = 1 + \cos(2000\pi t) + \sin(4000\pi t)$. It must be sampled at a minimum of

a) 8000 samples per second b) 2000 samples per second
c) 4000 samples per second d) 6000 samples per second

16. For an energy signal the average power is.....

c) infinite b) finite c) constant d) zero

17. In regards to the bandwidth requirement, DSB-AM is same to .....

a) full AM b) VSB AM
c) baseband message signal d) FM

18. The energy spectral density (ESD) of the unit impulse signal $\delta(t - t_0)$ will be.....

a) t_0 b) 0 c) t_0^2 d) 1

19. The frequency response of a zero order reconstruction system is.....

a) rectangular pulse b) triangular pulse
c) sinc function d) impulse function

20. For a CT ideal frequency selective low pass filter, the frequency response $H(j\omega)$ satisfies:

a) $|H(j\omega)| = \begin{cases} 1, & for\ |\omega| > \omega_c \\ 0, & for\ \omega_c > |\omega| \end{cases}$ b) $|H(j\omega)| = \begin{cases} 1, & for\ |\omega| < \omega_c \\ 0, & for\ \omega_c < |\omega| \end{cases}$

c) $|H(j\omega)| = \begin{cases} 1, & for\ \omega < \omega_c \\ 0, & for\ \omega_c < \omega \end{cases}$ d) $|H(j\omega)| = \begin{cases} 1, & for\ \omega > \omega_c \\ 0, & for\ \omega_c > \omega \end{cases}$

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SECTION "B"

[5Q × 11 = 55 marks]

Attempt *ANY FIVE* questions. Assume suitably for any missing information.

1. a. For the following input output relationship, determine whether the corresponding system is linear, time invariant, invertible and stable or not. [4]

$$y(t) = t^2 x(t-1)$$

b. Define odd and even signals with examples. Show that if a DT signal $x[n]$ is an odd signal, then, [3]

$$\sum_{n=-\infty}^{\infty} x[n] = 0$$

c. Using graphical fold and shift method, find the convolution of following two CT signals: [4]

$$x(t) = \begin{cases} 1, & 0 < t < 1 \\ 0, & otherwise \end{cases}$$

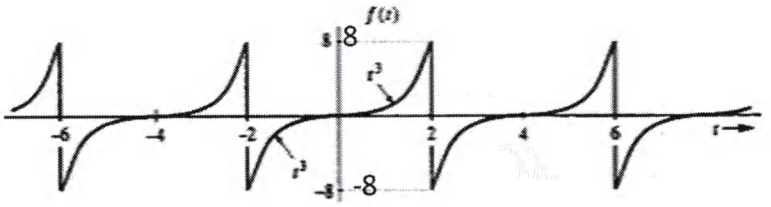
$$h(t) = \begin{cases} 2t, & -1 < t < 1 \\ 0, & otherwise \end{cases}$$

Show all relevant intermediate plots.

2. a. Determine whether the following signals are periodic or not. If periodic, find the fundamental period of the signal. [3]

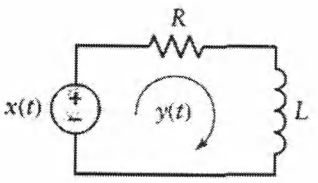
i) $x(t) = 2\sin\left(5t + \frac{\pi}{2}\right)$
ii) $x[n] = 2\sin[5n + \frac{\pi}{2}]$
iii) $x[n] = \cos[0.01\,\pi n]$

b. Find the instantaneous and average power of the following signal. Is this a power signal? [2]

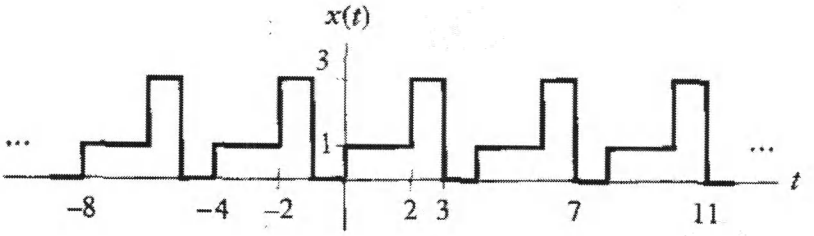


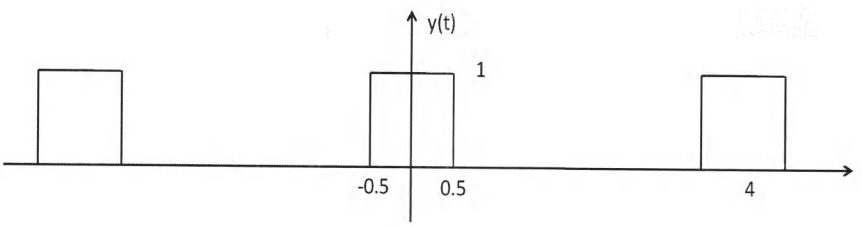
c. A DT LTI system has impulse response $h[n]$. Derive the conditions for the system to be memoryless, causal and stable. [3]

d. For the RL circuit shown below, voltage $x(t)$ is the input signal while the current $y(t)$ is the output. The differential equation representing the system is $Ry(t) + L\frac{dy(t)}{dt} = x(t)$. Solve the differential equation to find the total solution for the output current if the input is $x(t) = cos\ t$. Assume that $L = 1\ H$, $R = 1\Omega$ and $y(0) = 2A$. [3]



3. a. The figure below shows a CT periodic signal $x(t)$. Use the definition of complex exponential Fourier series to find the FS coefficients a_k. [4]

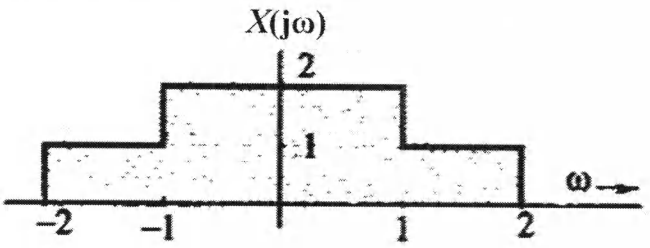




Consider that the FS coefficients of the signal $y(t)$ are b_k. Find the expression of a_k in terms of b_k.

b. What do you understand by the Gibb's phenomenon? Explain in context of Fourier series. [3]

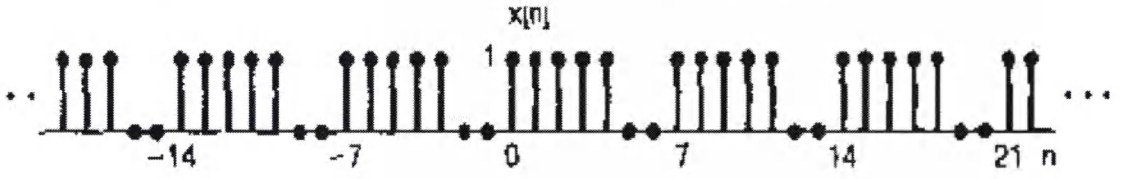
c. State and prove the time shifting property of Fourier transform. Find the inverse Fourier transform of the following spectrum. [4]



4. a. A DT signal is given below. Find the DTFT of the signal. Also obtain the expression for the magnitude and phase spectrum. [3]

$$x[n] = 2(3)^n u[-n]$$

b. Find the exponential Fourier Series of the periodic signal shown below: [3]



c. Laplace transform and Fourier transform both can be used to represent CT signals in frequency domain. Explain the relations between them and also their respective applications. [2]

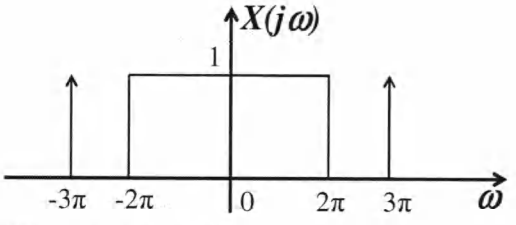
d. As Nyquist theorem states, for a band limited CT signal to be properly represented by its samples, it must be sampled at a frequency at least greater than twice the highest frequency content present in the signal. Prove the Nyquist theorem with an example. [3]

5. a. Explain DSB-AM with time domain and frequency domain expressions.
A single tone message signal $x(t) = cos(2\pi f_m t)$is used to DSB-AM a carrier signal $c(t) = cos(2\pi f_c t)$. Find the frequency domain representations of the modulated signal and sketch the spectrum. [4]

b. Explain the conditions for the distortionless transmission? [3]

c. A CT signal $x(t)$ has the Fourier transform $X(j\omega)$ shown below. If the signal is sampled with sampling time T, sketch the spectrum of the sampled signal for the following values of T: [4]

i) $T = 0.5$
ii) $T = 0.25$



Does both of above sampling satisfy Nyquist criteria?

6. a. What do you understand by ESD and PSD of a signal? Explain with mathematical expressions. [2]

b. How does the frequency response of an ideal filter differ from that of a practical response? Explain with reference to that of a low pass filter response. [3]

c. Let $x[n] = \delta[n] + 2\delta[n-1]$ and $h[n] = 2\delta[n+1] + 2\delta[n-1]$.Using the definition of convolution sum, compute and plot $y[n] = x[n] * h[n]$. [3]

d. Find the complex exponential Fourier series coefficients of the following CT periodic impulse train. [3]