Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2017

Level : B. E.
Year : III
Course : EEEG 313
Semester : I
Exam Roll No. :
Time: 30 mins
F. M. : 20
Registration No.:
Date : APR 18 2017

SECTION "A"
[20Q × 1 = 20 marks]

1. The CT complex exponential signal $x(t) = e^{j2t}$ is .....
   a) a non periodic signal.
   b) a periodic signal with fundamental period of 2π seconds.
   c) a periodic signal with fundamental period of π seconds.
   d) a periodic signal with fundamental period of 2 seconds.

2. The DT exponential signal $x[n] = e^{j\frac{3\pi}{4}n}$ is periodic with fundamental period.....
   c) $\frac{8}{3}$ b) 3 c) 8 d) the signal is not periodic

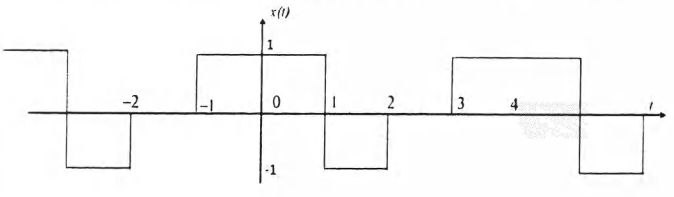
3. Colour image is an example of .....dimensional signal.
   c) 1 b) 2 c) 3 d) 4

4. If $\delta(t)$ and $u(t)$ represent CT unit impulse and unit step signals, which of following relationship is NOT CORRECT?
   a) $\delta(t) = \int_{-\infty}^{t} u(\tau)d\tau$ b) $\int_{-\infty}^{t} k\delta(\tau)d\tau = ku(t)$
   b) $\int_{-\infty}^{\infty} u(t)\delta(t-1)dt = 1$ d) $u(t)\delta(t-1) = \delta(t-1)$

5. The DT system $y[n] = 2x[n] + 3$ is .....
   a) a non linear system as it does not satisfy homogeneity property.
   b) a non linear system as it does not satisfy additivity property.
   c) a non linear system as it does not satisfy both homogeneity and additivity property.
   d) a linear system

6. The impulse response of a LTI system is $h(t) = e^{-t}u(t)$. The system is....
   a) causal and memoryless. b) non causal and has memory.
   c) non causal and memoryless. d) causal and has memory.

7. The FS coefficient a_o of the signal shown in figure below is:



   a) 0
   b) $\frac{1}{4}$
   c) $\frac{1}{2}$
   d) 1

8. For a LTI system, if the impulse response is absolutely integrable, it guarantees that the system is..
   a) stable b) causal c) invertible d) memoryless

9. Which is NOT TRUE about DTFS?
   a) It is an infinite series
   b) coefficients are periodic
   c) It provides discrete spectrum
   d) It does not have convergence issues

10. Fourier transform of $\delta(t-1)$ is
   a) 1
   b) $e^{-jt\omega}$
   c) $e^{-j\omega}$
   d) $e^{j\omega}$

11. The FT of the signal $e^{-at}u(t)$ is $\frac{1}{a+j\omega}$. The FT of the signal $e^{at}u(-t)$ is thus,...
   a) $\frac{1}{-a-j\omega}$
   b) $\frac{1}{a-j\omega}$
   c) $\frac{1}{-a+j\omega}$
   d) $\frac{1}{a^2-\omega^2}$

12. What is the FT of unit step signal $u(t)$?
   a) $\pi\delta(\omega)$
   b) $\pi\delta(\omega)+\frac{1}{j\omega}$
   c) $\frac{1}{j\omega}$
   d) Its FT does not exist

13. For a signal $x(t)$, $X(j\omega)=0\ for\ |\omega|>5000\pi$. The signal should be sampled with sampling time T
   a) less than 0.2 ms
   b) greater than 0.2 ms
   c) equal to 0.2 ms
   d) greater than 0.1 ms

14. The highest frequency present in the DSB-SC signal is .....
   a) twice the largest frequency present in message signal.
   b) twice the sampling frequency.
   c) sum of sampling frequency and the largest frequency in message signal
   d) difference of sampling frequency and the largest frequency in message signal.

15. If $x[n]$ has DTFT $X(e^{j\Omega})$, which is not TRUE?
   a) $X(e^{j(\Omega+2\pi)})=X(e^{j\Omega})$
   b) $x^*[n]\leftrightarrow X^*(e^{j\Omega})$
   c) $x[-n]\leftrightarrow X(e^{-j\Omega})$
   d) $nx[n]\leftrightarrow j\frac{dX(e^{j\Omega})}{d\Omega}$

16. Energy signals have.....
   a) 0 total energy
   b) infinite average power
   c) Infinite total energy
   d) 0 average power

17. Envelope detector is suitable to demodulate
   a) All amplitude modulated signals
   b) SSB modulated signals only
   c) DSB-SC modulated signals only
   d) Full AM only

18. The Nyquist rate for sampling the signal $x(t)=1+\cos(2000\pi t)+\sin(4000\pi t)$ is
   a) $8000\ \pi$
   b) $4000\ \pi$
   c) $2000\ \pi$
   d) $1000\ \pi$

19. If a filter provides a constant delay to all frequencies, its
   a) phase is constant for all frequencies
   b) phase is zero
   c) phase varies linearly with frequency
   d) phase response of a filter is not related to the delay

20. Noises are examples of .....
   a) Periodic signals
   b) Deterministic signals
   c) Energy signals
   d) Random signals

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SECTION "B"

1. a. Write short notes on CT and DT real and complex exponential signals. Include suitable figures in your explanation. [3]

   b. Determine whether following systems are linear, time invariant and causal or not: [4]
      i) $y(t) = x(t-2) + x(t+2)$
      ii) $y[n] = x[-n] + 1$

   c. Impulse response of a LTI zero order hold system is $h(t)$ as defined below. Find the output of the system when the input is a rectangular pulse $x(t)$ also defined below. Use graphical invert and shift method to evaluate the convolution. Show all relevant figures. [4]

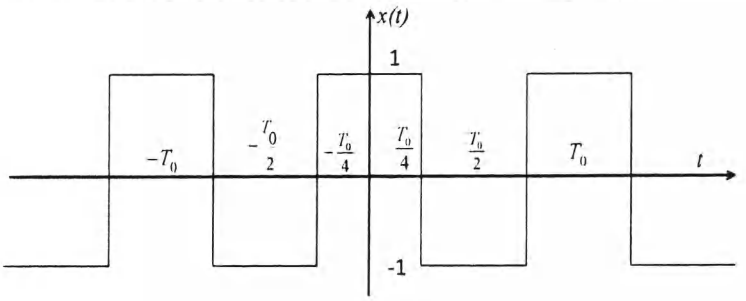
$$h(t) = \begin{cases} 1, & for\ 0 < t < T \\ 0, & otherwise \end{cases} \text{ and } x(t) = \begin{cases} 1, & for\ -\frac{T}{2} < t < \frac{T}{2} \\ 0, & otherwise \end{cases}$$

   Sketch the final output signal.

2. a. Define commutative, distributive and associative properties of the convolution integral. Explain how these properties can be used to simplify the analysis of cascade and parallel connection of LTI systems. [3]

   b. Consider the LTI system described by the linear constant coefficient difference equation $y[n] = \frac{1}{2}y[n-1] + x[n]$. Suppose that the input to the system is $x[n] = \left(\frac{1}{3}\right)^n u[n]$. Find the output of the system by solving the difference equation, if the system is initially at rest, ($y[0] = 0$ for this case). [4]

   c. A periodic rectangular wave is shown below. Find the Exponential Fourier series coefficients of the signal. Also find the values of first three coefficients. [4]



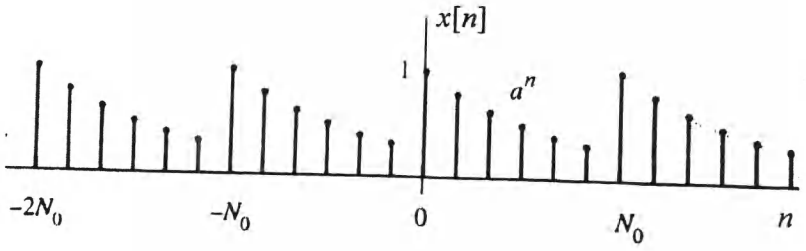
3. a. Show that complex exponential signals are the eigen functions of both CT and DT LTI systems. Also identify the corresponding eigen values. [3]

   b. A linear combination of harmonically related sinusoidal signals is given as: [3]

$$x(t) = 1 + \sin(\omega_0 t) + 2\cos(\omega_0 t) + \cos\left(2\omega_0 t + \frac{\pi}{2}\right)$$

   Find the exponential Fourier series coefficients and hence the magnitude and phase spectrum of the signal.

c. Find the DTFS coefficients of the periodic DT signal shown below: [3]



d. Explain what you understand by Gibb's phenomena in context of Fourier series. [2]

4. a. Using the definition, find the Fourier transform of the signal given below: [3]

$$f(t) = \begin{cases} e^{-at}, & 0 < t < T \\ 0, & else\ where \end{cases}$$

b. State and prove the frequency shifting property of Fourier transform. Using this property, obtain the Fourier transform of the amplitude modulated signal of a rectangular pulse defined below: [4]

$x(t) = f(t)\cos\omega_0 t$

Where, $f(t) = \begin{cases} 1, & for -1 < t < 1 \\ 0, & otherwise \end{cases}$

c. Derive the inverse and forward Fourier transform equations. [4]

5. a. Using definition of inverse Fourier transform, find the time domain representation of the signal whose DTFT is given as: $X(e^{j\Omega}) = \begin{cases} 2j, & 0 < \Omega \leq \pi \\ -2j, & -\pi < \Omega \leq 0 \end{cases}$ [

b. Using the definition of DTFT, calculate the DTFT of the signal: [

$$x[n] = \left(\frac{1}{2}\right)^{|n-1|}$$

c. State and prove differentiation in frequency property of DTFT. [2]

d. Explain various types of CT and DT filters based on their frequency responses. [3

6. a. With suitable spectrums of CT signal and its sampled version, demonstrate the condition for samples to exactly represent the CT signal. Thus, define Nyquist sampling theorem and Nyquist rate. [3]

b. Obtain the minimum order required for a normalized Butterworth filter to meet following specifications:

$$\alpha_s = 20\ dB, \alpha_p = 2\ dB, \omega_s = 20, \omega_p = 10$$

c. Explain DSB-SC AM with relevant time domain and frequency domain expressions. Find and plot the DSB-SC spectrum when the message signal is a single tone signal $m(t) = A\cos\omega_m t$. [4]

d. What do you understand by PSD and ESD of a signal? [2]