KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Mark Scored:

Level : B.E.
Year : III
Course : EEEG 313
Semester : I
Exam Roll No. :
Time: 30 mins.
F. M. : 20
Registration No.:
Date 07 JUN 2019

SECTION "A"
[20Q. × 1= 20 marks]

Tick [√] the most appropriate answer from the given options.

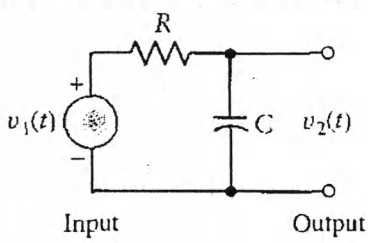
1. The CT complex exponential signal $x(t) = Ae^{j\omega_0 t}$ is .....
   a. always periodic
   b. always aperiodic
   c. conditionally periodic depending on the value of A
   d. conditionally periodic depending on the value of $\omega_0$

2. The impulse response of the system $y(t) = x(t)$ is .....
   a. $u(t)$ b. $t\,u(t)$ c. $\delta(t)$ d. $e^{jt}$

3. The system with input output equation $y(t) = t\,x(t-1)$ is.....
   a. causal and time invariant
   b. causal and time variant
   c. non causal and time invariant
   d. non causal and time variant

4. For a periodic DT signal $x[n]$ with fundamental period N, which of the following is NOT true?
   a. $x[n] = x[n-N]$
   b. $x[n] = x[n+N]$
   c. $x[n] = x[n-\frac{N}{2}]$
   d. $x[n] = x[n-2N]$

5. Is RC circuit shown below a causal system?




   a. Yes
   b. No
   c. Depends on the value of R
   d. Depends on the value of C

6. An LTI system has the differential equation given as:
   $\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} + y(t) = 2\frac{dx(t)}{dt} + 3x(t)$. What is the corresponding frequency response?

   a. $\frac{1+j2\omega-\omega^2}{3+j2\omega}$ b. $\frac{3+j2\omega}{1+j2\omega-\omega^2}$ c. $\frac{3+j2\omega}{1-j2\omega+\omega^2}$ d. $\frac{3-j2\omega}{1+j2\omega-\omega^2}$

7. The Fourier transform of $x(t) = \delta(t-1)$ is.....
   a. $e^{-j(\omega+1)}$ b. $\frac{1}{1+j\omega}$ c. $e^{j\omega}$ d. $e^{-j\omega}$

8. Which of the following is NOT the correct Fourier transform pair?
   a. $e^{-at}u(t) \overset{FT}{\longleftrightarrow} \frac{1}{a+j\omega}$
   b. $e^{-a|t|} \overset{FT}{\longleftrightarrow} \frac{2a}{a^2+\omega^2}$
   c. $\delta(t) \overset{FT}{\longleftrightarrow} 1$
   d. $u(t) \overset{FT}{\longleftrightarrow} \frac{1}{j\omega}$

9. A periodic CT impulse train with fundamental period T has Fourier series coefficients $a_k = \frac{1}{T}$. The Fourier transform $(X(j\omega)$ of the signal is:

a. $X(j\omega) = \sum_{k=-\infty}^{\infty} \delta(\omega - \frac{2\pi k}{T})$ b. $X(j\omega) = \frac{2\pi}{T}\sum_{k=-\infty}^{\infty} \delta(\omega - \frac{2\pi k}{T})$

c. $X(j\omega) = \frac{T}{2\pi}\sum_{k=-\infty}^{\infty} \delta(\omega - \frac{2\pi k}{T})$ d. $X(j\omega) = \sum_{k=-\infty}^{\infty} \delta(\omega - \frac{T}{2\pi k})$

10. The Discrete Time Fourier Transform $X(e^{j\Omega})$ is periodic with period.....

a. $2\pi$ b. $\pi$ c. T d. $\frac{1}{2\pi}$

11. For the sinusoidal signal $x(t) = \sin(\omega t)$, the number of non zero exponential FS coefficients are...

a. $2\pi$ b. 1 c. 2 d. 3

12. The Fourier series coefficients of a periodic CT signal is .....

a. may be real or complex b. always real

c. always complex d. time dependent

13. The minimum sampling frequency required to sample the signal $x(t) = 2\ \sin\left(2000\pi t + \frac{\pi}{2}\right)$ is...

a. 4000 Hz b. 2000 Hz c. 1000 Hz d. 4000 $\pi$ Hz

14. Impulse response of a linear interpolation (reconstruction) system is .....

a. sinc signal b. triangular pulse

c. rectangular pulse d. raised cosine pulse

15. A periodic signal is an example of .....signal also.

a. even signal b. odd signal c. energy signal d. power signal

16. When a system is described by a linear constant coefficient difference equation of the form, $\sum_{k=0}^{N} a_k y[n-k] = \sum_{k=0}^{M} b_k x[n-k]$, the order of the system is.....

a. M b. N

c. M or N whichever is larger d. M or N whichever is smaller

17. Whenever amplitude modulation is chosen, the transmission bandwidth requirement is.....

a. less than that of baseband signal b. always equal to that of baseband signal

c. always twice that of baseband signal d. none of above

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

a. 1 b. 0 c. $t_0^2$ d. $t_0$

19. A real time system cannot be.....

a. non linear b. time variant

c. non causal d. unstable

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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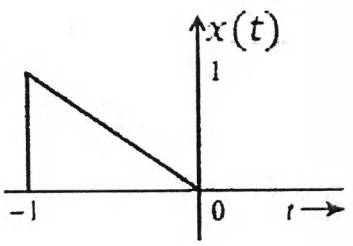
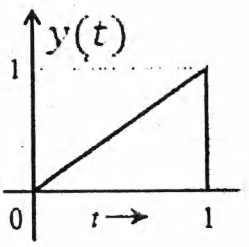
SECTION "B"
[5Q. × 11 = 55 marks]

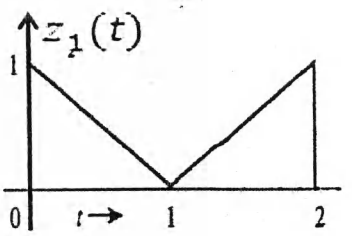
Attempt *ANY FIVE* questions. Assume suitably for any missing information.

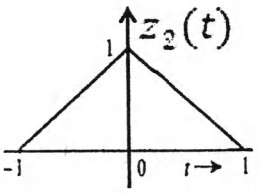
1. a. Explain following signal transformations with suitable examples and figures. [4]
   i) Time shifting ii) Time inversion
   iii) Time scaling iv) Signal addition

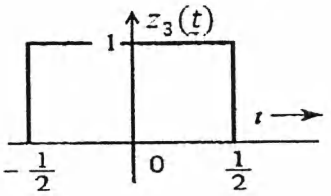
   b. CT signals $x(t)$ and $y(t)$ are shown below. Express signals $z_1(t)$, $z_2(t)$, $z_3(t)$, $z_4(t)$ also shown below, in terms of $x(t)$, $y(t)$ and their time shifted, time inversed and time scaled versions. [4]

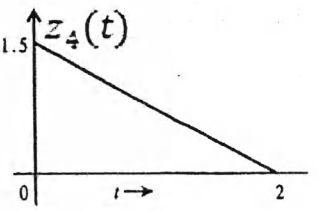



   c. A DT moving average system whose output is the average of the three recent values of the input signal has input–output equation defined below. Determine if the system is linear, causal, time invariant and stable or not. [3]

$$y[n] = \frac{1}{3}(x[n] + x[n-1] + x[n-2])$$

2. a. Exponential signals play a very important role in signal and system analysis. Explain with neat sketches the various types of real and complex exponential CT signals. [3]

   b. An LTI system has the impulse response $h[n] = u[n]$. The input to the system is $x(t) = 2e^{-2t}u(t)$. Using the graphical interpretation of convolution, (fold, shift and overlap method), find the output of the system for all time. Show all signals involved with neat and well labeled sketches. [3]

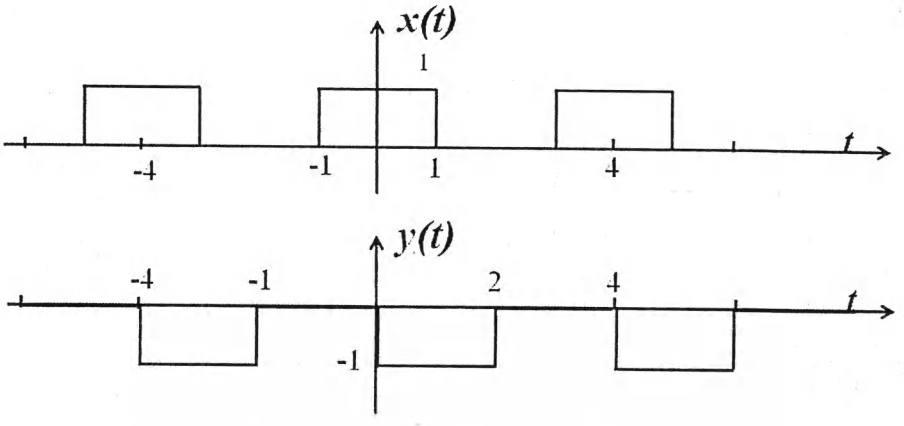
   c. Two LTI systems are connected in parallel. If $h_1[n] = \{1, 2, 3, 4, 5, 6\}$ and $h_2[n] = \{6, 5, 4, 3, 2\}$, what will be the impulse response $h[n]$ of the total system? [2]

   d. Derive the condition that the impulse response of an LTI system should satisfy for the system to be stable. Also using the condition, check whether the following LTI system is stable or not. [3]

$$h[n] = 2^n u[n+1]$$

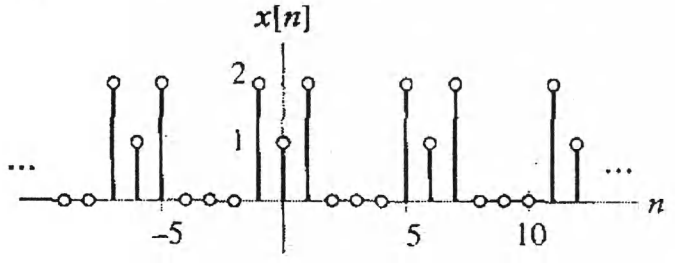
3. a. State synthesis and analysis equation of CTFS. A periodic CT signal $x(t)$ is shown below. The Fourier series coefficients of the signal are $a_k = \begin{cases} \frac{\sin(\frac{\pi k}{2})}{k\pi} & for\ k \neq 0 \\ \frac{1}{2} & for\ k = 0 \end{cases}$

Using the properties of the CT Fourier series, find the FS coefficients of the signal $y(t)$. [4]



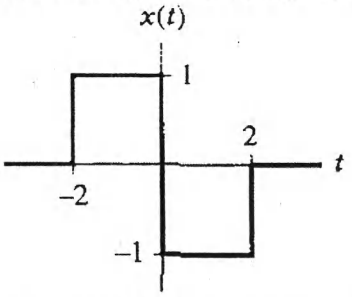

b. What do you understand by the Gibb's phenomenon in Fourier series? Explain with suitable example and figures. [3]

c. What are the major differences between CTFS and DTFS? Using the definition of the DTFS, show that the FS coefficient of the DT periodic signal show below is:
$a_k = \frac{1}{6} + \frac{2}{3}cos\left(\frac{\pi}{3}k\right)$ [4]




4. a. Use the definition of Discrete Time Fourier transform to obtain the Fourier transform of: $x[n] = \left(\frac{1}{2}\right)^n u[n-4]$ [3]

b. Use the definition of Fourier transform to obtain the Fourier transform of: [3]




c. State, prove and explain the time shifting property of CTFT. [3]

d. Compute the total energy of the signal: $x(t) = e^{-2t}u(t-2)$. What will be its average power? [2]

5. a. Fourier transform is conveniently expressed as magnitude and phase spectrum ($X(j\omega) = |X(j\omega)|e^{j\angle X(j\omega)}$). The Fourier transform of a signal $x(t)$ has magnitude and phase spectrum given as: [3]

$$|X(j\omega)| = \begin{cases} 1, & for \quad -2 \leq \omega \leq 2 \\ 0, & Otherwise \end{cases}$$

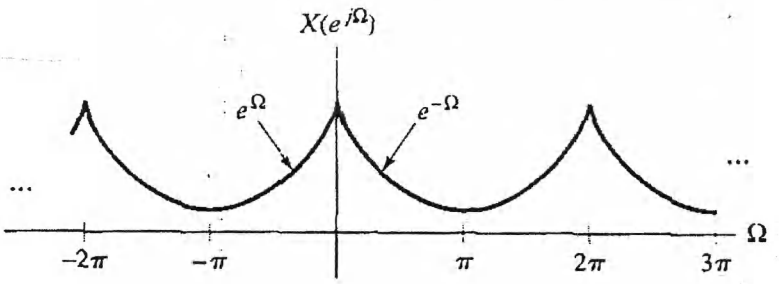
$$\angle X(j\omega) = \begin{cases} -2\omega, & for \quad -2 \leq \omega \leq 2 \\ 0, & Otherwise \end{cases}$$

Use the definition of inverse Fourier transform to find the signal $x(t)$.

b. State some application of filters. Show your knowledge about Butterworth and Chebyshev filters with relevant expressions, characteristics and figures. [4]

c. Explain full AM and DSB-SC AM with time domain and frequency domain expressions. Supplement your answer with suitable examples and figures. [4]

6. a. A DT signal has the DTFT spectrum as shown below. Obtain the signal $x[n]$. [3]




b. State and prove Parseval's relationships for energy signals. [3]

c. State and prove the periodicity and linearity properties of DTFT. [3]

d. Explain impulse train sampling with necessary expressions and figures. [2]