

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2018

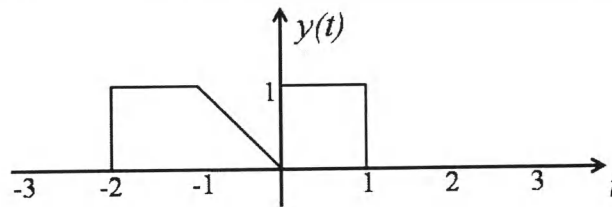
Level : B. E.
Year : III
Time : 2 hrs. 30 mins.

Course : EEEG 313
Semester : I
F. M. : 55

SECTION "B"

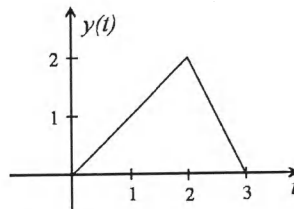
Attempt *ANY FIVE* questions. Assume suitably for any missing information.

1. a. Any signal can be expressed as the sum of an even and an odd signal. For the signal given in the figure below, find and sketch even and odd parts of the signal. [3]



- b. Explain major signal classifications with examples. [4]

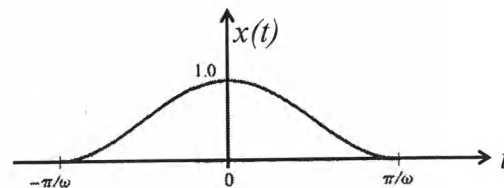
- c. Express the following signal using unit step and shifted unit step signals. [2]



- d. Define linearity of systems. Describe the steps to check the linearity of a system with input $x[n]$ and output $y[n]$. [2]

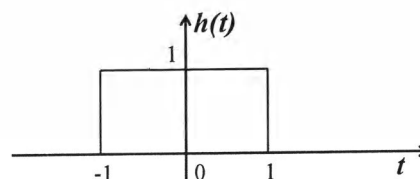
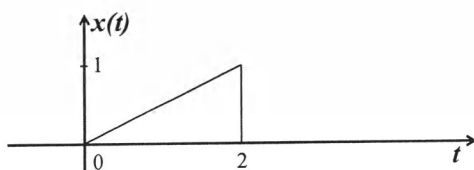
2. a. The raised cosine pulse $x(t)$ shown below is defined as: [3]

$$x(t) = \begin{cases} \frac{1}{2}[\cos(\omega t) + 1], & -\pi/\omega \leq t \leq \pi/\omega \\ 0, & \text{otherwise} \end{cases}$$



Find the total energy of the pulse.

- b. An LTI system has the input and impulse responses $x(t)$ and $h(t)$ as depicted in figures below. Find the output of the system as provided by the convolution operation. Use graphical method to compute the convolution and show all necessary intermediate sketches. [4]

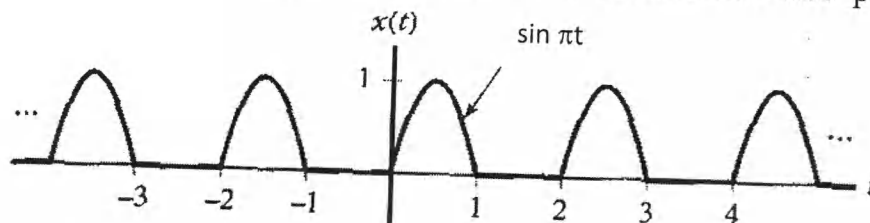


- c. Convolution of two signals $x_1[n]$ and $x_2[n]$ is defined as [4]

$$x_3[n] = \sum_{k=-\infty}^{\infty} x_1[k]x_2[n-k].$$

State and prove commutative, distributive and associative properties of convolution. Explain the consequences of these properties on analyzing LTI systems.

3. a. Find the Fourier Series coefficients of the CT periodic signal $x(t)$ shown below (use exponential FS). Find the values first three coefficients and plot the spectrum. [4]



- b. A DT sinusoidal signal $x[n] = \sin(\omega_0 n)$ is periodic only when $\frac{2\pi}{\omega_0}$ is an integer or a ratio of integers. Find the exponential Fourier series coefficients and plot the spectrum of such signal for: i) $\omega_0 = \frac{2\pi}{5}$ ii) $\omega_0 = \frac{6\pi}{5}$ iii) $\omega_0 = 10\pi$ [4]

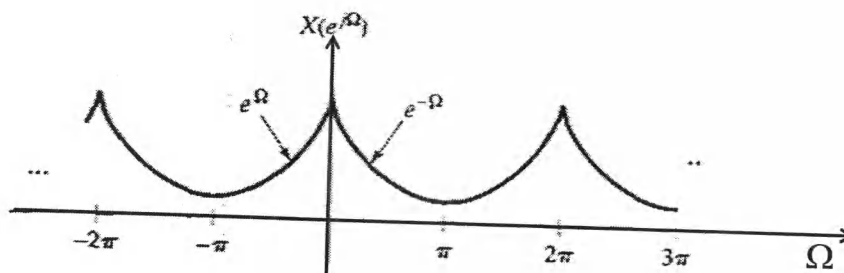
- c. State convolution integral and show with derivation and explanation that, for an LTI system, the output signal is given by the convolution of input signal with the impulse response of the system. [3]

4. a. Using the defining equation for the DTFT evaluate the frequency domain representation for the time domain signal given as: [3]

$$x[n] = \left(\frac{1}{2}\right)^n u[n-4]$$

Also find the expressions for magnitude and phase spectra.

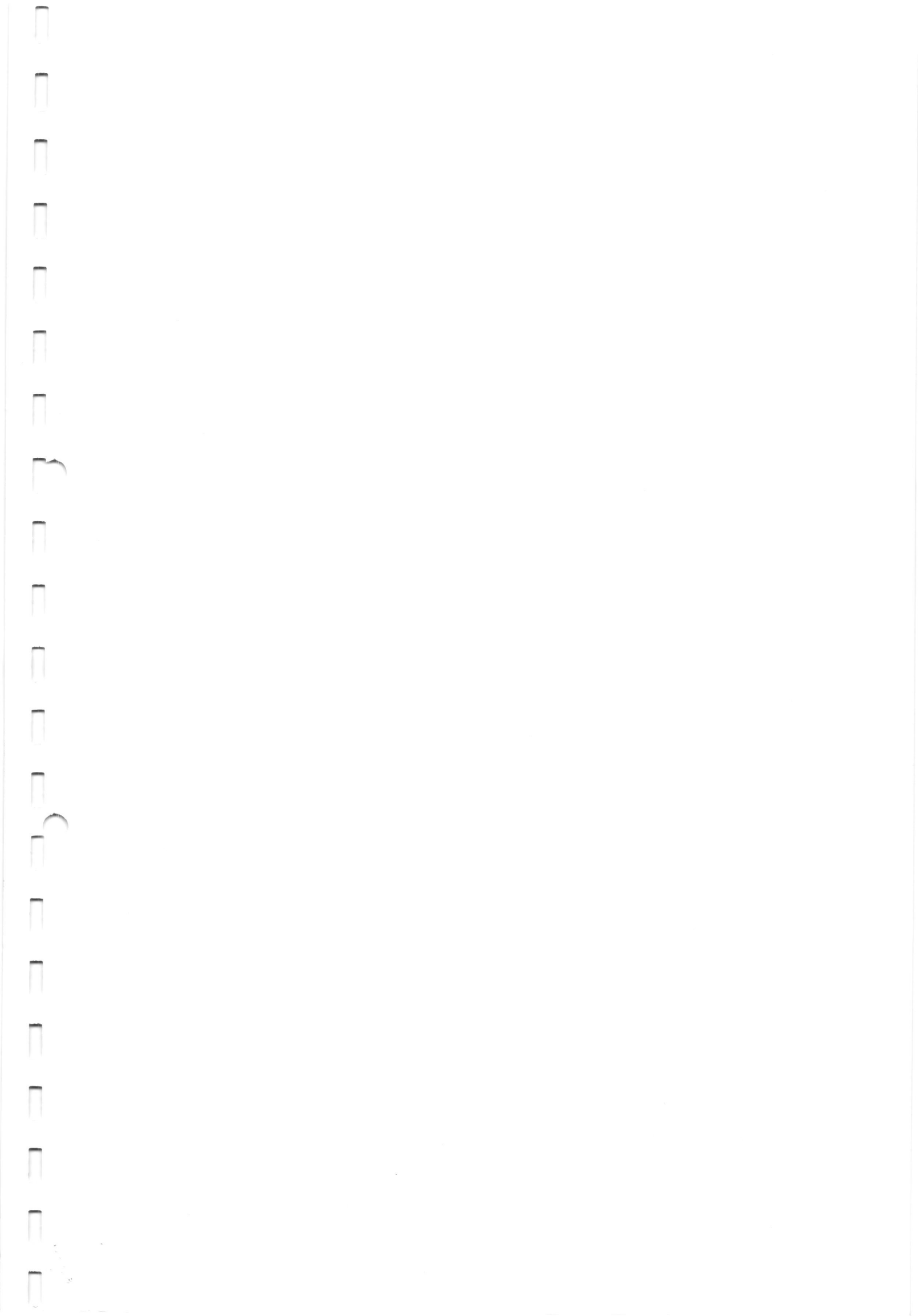
- b. The DTFT of a signal is shown below. Find the time domain signal that it represents. [3]



- c. Periodic signals are represented in frequency domain by the Fourier series, whereas Fourier transform is used as representation for non periodic signals. Derive the forward and inverse transform equations for the Continuous Time Fourier Transform. [3]

- d. State and prove the time shifting property of CTFS. [2]

5. a. A gate function $rect(t)$ is defined as: $rect(t) = \begin{cases} 1, & \text{for } |t| < \frac{1}{2} \\ 0, & \text{otherwise} \end{cases}$. Using the [3]
definition of CTFT, show that, $rect(t) \xrightarrow{CTFT} sinc\left(\frac{\omega}{2\pi}\right)$. Where, $sinc(\omega)$ is
a function defined as: $sinc(\omega) = \frac{\sin \pi\omega}{\pi\omega}$
- b. Impulse train sampling is the common way to model the sampling operation. [4]
Obtain the time domain and frequency domain equations representing impulse
train sampling. Also explain the ideal reconstruction used to recover the
original CT signal from its samples. Use sketches if relevant.
- c. Among the full AM, DSB-SC AM and SSB AM, which scheme is the most [4]
efficient in terms of power and bandwidth? Why?
A single tone message signal $x(t) = \cos(1000\pi t)$ is used to amplitude
modulate a carrier signal $c(t) = \cos(10000\pi t)$. Find the frequency domain
representations of the modulated signal if general AM scheme is used. Sketch
the spectrum.
6. a. Define various types of frequency selective filters based on frequency [3]
responses. Show their frequency responses for both the CT and DT filters.
- b. Consider that a system with input $x[n]$ and output $y[n]$ is described by the [3]
difference equation $y[n] - \frac{1}{2}y[n-1] = x[n]$. The system is excited by the
input $x[n] = \left(\frac{1}{3}\right)^n u[n]$. Assuming that $y[n] = 0$, for $n < 0$, solve the
difference equation and find the output of the system for $n \geq 0$. Use classical
method to solve the equation.
- c. Find the impulse response of an ideal low pass filter and prove that it is a non [3]
causal system.
- d. What do you understand by ESD and PSD? [2]



Mark Scored:

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Level : B. E.
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Exam Roll No. : Time: 30 mins.

F. M. : 20

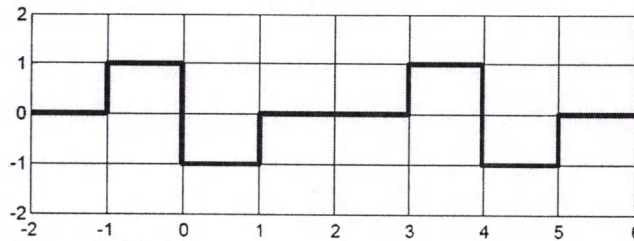
Registration No.:

Date : MAR 16 2018

SECTION "A"
[20 Q. × 1 = 20 marks]

- 1) If a signal is periodic with fundamental frequency ω_0 , it is also periodic with frequency.....
- a) $2\omega_0$ b) ω_0^2 c) $\frac{\omega_0}{2}$ d) $\sqrt{\omega_0}$

- 2) The FS coefficient a_0 of the signal shown in figure below is:



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

- 3) Which of the following signal is an even signal?

- a) $x(t) = t^2 + 2t + 2$ b) $x(t) = t^2 + 2t$
c) $x(t) = t^2 + 2$ d) $x(t) = 2t + 2$

4) If $x(t) = 0.5^t$, $x(t)\delta(t) = \dots \dots \dots$

- a) 1 b) $\delta(t)$ c) $0.5\delta(t)$ d) 0.5

- 5) An accumulator is a DT system that has input-output relationship $y[n] = \sum_{k=-\infty}^n x[k]$. What is its impulse response?

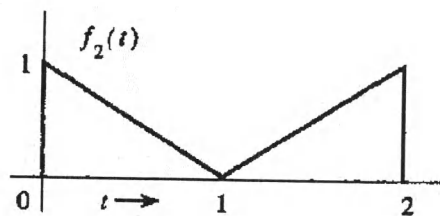
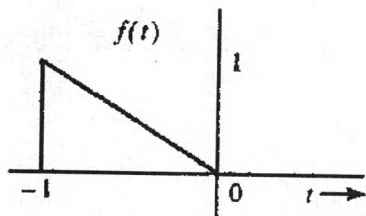
- a) $\sin\omega n$ b) $\text{sinc } n$ c) $\delta[n]$ d) $u[n]$

- 6) A system is defined by the differential equation given as below. The system is.....

$$\frac{dy(t)}{dt} + 3ty(t) = t^2x(t)$$

- a) linear and time invariant b) non linear and time invariant
c) non linear and time variant d) linear and time variant

- 7) Which is the correct relationship between the signals shown below?



- a) $f_2(t) = f(t + 1) + f(-t - 2)$ b) $f_2(t) = f(t + 1) + f(-t + 1)$
 c) $f_2(t) = f(t - 1) + f(-t + 1)$ d) $f_2(t) = f(t - 1) + f(-t - 1)$
- 8) The impulse response of a LTI system is $h(t) = u(t)$. The system
- a) is BIBO stable b) is BIBO unstable
 c) is conditionally stable d) stability cannot be determined
- 9) A real CT signal has the FS coefficient $a_1 = \frac{1}{2j}$. Then which of following is correct?
- a) $a_{-1} = \frac{1}{2j}$ b) $a_{-1} = 2j$ c) $a_{-1} = -\frac{1}{2j}$ d) $a_{-1} = -2j$
- 10) For the Fourier series of a signal $x(t)$ to converge, which of the following is required?
- a) $\int_{-\frac{T}{2}}^{\frac{T}{2}} |x(t)| dt < \infty$
 b) $x(t)$ must have at least one discontinuity within its one period.
 c) $x(t)$ must be real valued
 d) $x(t)$ must be either even or odd signal.
- 11) The spectra provided by DTFS is.....
- a) discrete and aperiodic b) discrete and periodic
 c) continuous and periodic d) continuous and aperiodic
- 12) If the CTFT of a signal $x(t)$ can be written as $X(j\omega) = |X(j\omega)|e^{j\theta(\omega)}$, the CTFT of the signal $x(t - t_0)$ will be.....
- a) $|X(j\omega)|e^{j[\theta(\omega)+\omega t_0]}$ b) $|X(j\omega)|e^{j[\theta(\omega)-\omega t_0]}$
 c) $|X(j\omega)|e^{-j\omega t_0}$ d) $|X(j\omega)|e^{j\omega t_0}$
- 13) Fourier transform of unit impulse signal $\delta(t)$ is.....
- a) $\frac{1}{1+\omega^2}$ b) $\delta(\omega)$ c) 0 d) 1

