*Q*uestion *(1)*: Signal Manipulation: [30 Marks]

A. For the signal shown in figure (1) draw: **[10 Marks]**

- The signal delayed 2 sec, atenuated by 2 and compressed by 2.

- The signal DC shifted by (-1), advanced by 1 and expanded by 2.
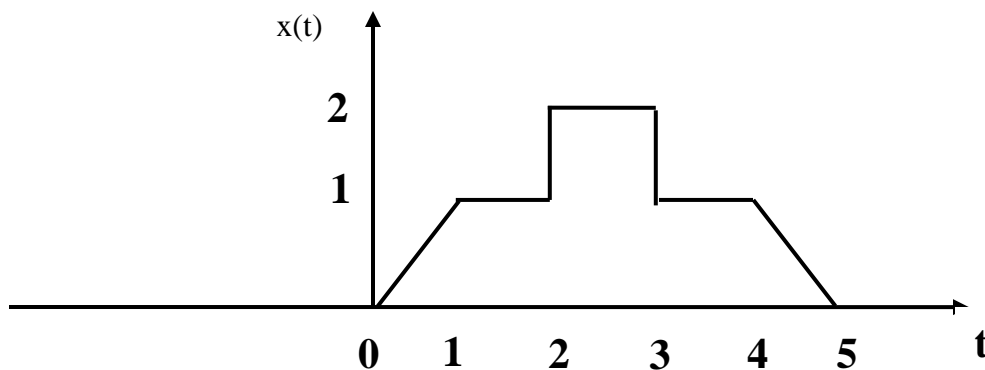
Figure (1)

B. Sketch and label the even and odd components of the signal shown in figure (1).**[8 Marks]**

C. For the signal x(t) shown in figure (1) find the size of: **[6 Marks]**

- x(t) [u(t) – u(t-1)].
- x(t) [u(t-1) – u(t-2)].

D. Show that the following system is Time-Invariant/Time-varying: **[3 Marks]**

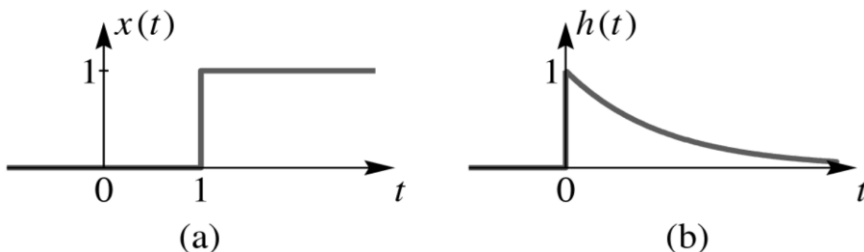- y(t) = sin (t) x(t-2).

E. Show that the following system is Invertible or not: **[3 Marks]**

- y(t) = 3 t x(t-2) - 2.

*Q*uestion *(2)*: Convolution and Fourier: [30 Marks]

A. Convolve the signals shown in figure(2): **[8 Marks]**

(a)　　　　　　　　　(b)　　　　　　Figure (2)

1

Where:

x(t) = u(t-1).

h(t) = e^{-t} u(t).

B. Use direct integration to find expression for: **[4 Marks]**

$$y(t) = e^{-at} u(t) * e^{-bt} u(t).$$

C. Find the trigonometric Fourier series and compact trigonometric Fourier series for the triangular periodic signal shown in Fig. 3 over the interval $-1 \le t \le 1$. **[8 Marks]**
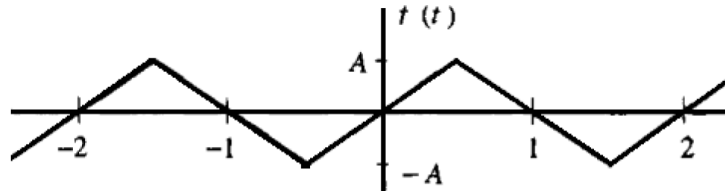

Figure (3)

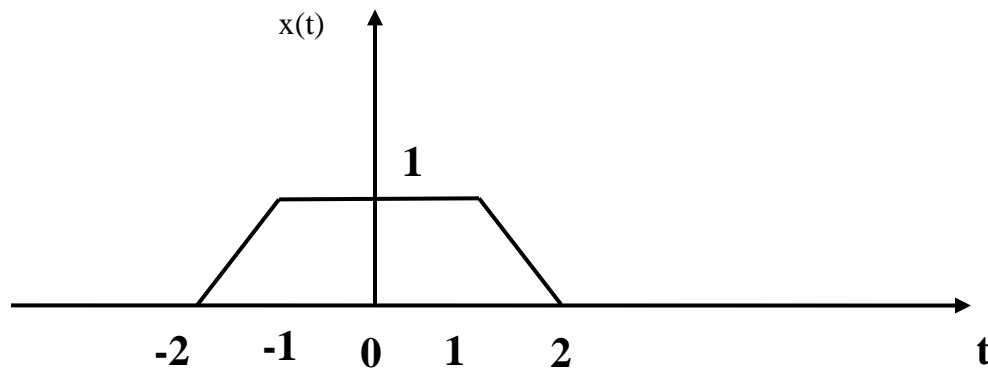D. Find the fourier transform of the signal shown in figure (4): **[6 Marks]**

Figure (4)

E. Use Harmonics Tabular Method to find the Fourier series coefficients for the signal samples shown in the next table **(get only the Dc component and the first harmonic coefficients): [4 Marks]**

V(t)	10	20	30	35	40	40	35	30	20	10	5	0
wt	30	60	90	120	150	180	210	240	270	300	330	360

Question (3): Sampling Theory and PCM: [30 Marks]

A. State the sampling theory. **[2 Marks]**

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B. Proof (mathematicaly) that the output spectrum of the sampled signal will be a duplicated version of the original spectrum. **[8 Marks]**

C. Define the Aliasing problem and show how you can avoid it. **[4 Marks]**

D. If x(t) is the input signal to PCM encoder (Sound card in your PC): **[8 Marks]**

   x(t) = speech signal with peak to peak (5 v)

   Find:

   - Sampling frequency at Nyquist rate.
   - If the step voltage between 2 consecutive quantum levels (Δv) = 10 mv:
     - What is the number of levels?
     - What is the number of bits per sample?
     - What is the bit rate?

E. Explain the PCM Encoder and Decoder **[6 Marks]**.

F. In your opinion what are the advantages and disadvantages of Delta Modulation? **[2 Marks]**

GOOD LUCK

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