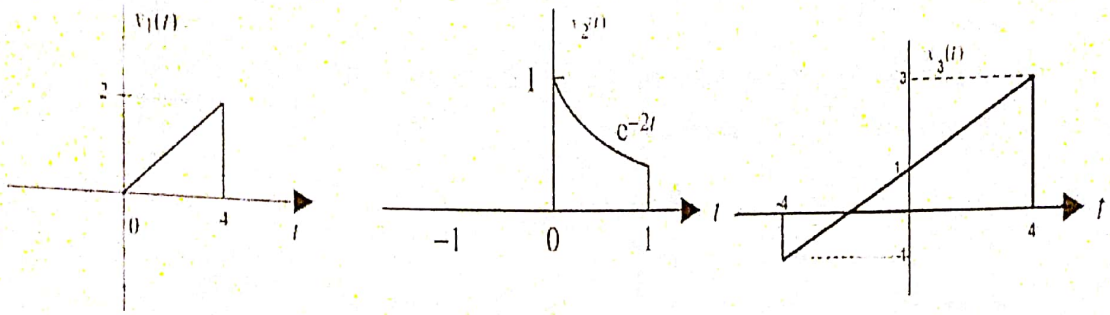
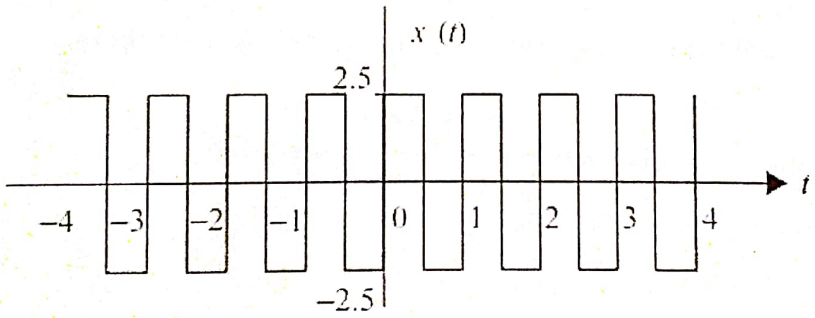
Q1) a-Represent the signals shown in the figure in terms of the unit step function u(t). [6]




b- Consider the following signal: [4]

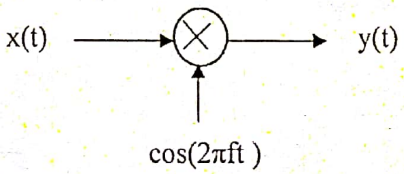

Determine the values of T for which the resulting signal is **(i)** an even function, and **(ii)** an odd function

c- Calculate the average power of the signal x(t): [4]



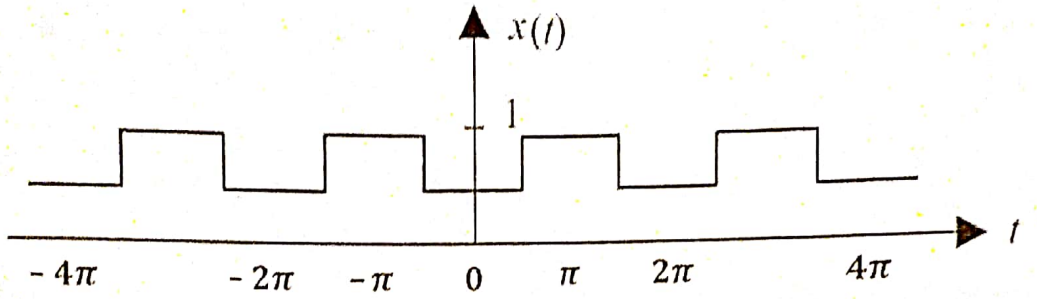

Q2) a-For the system represented by the equation $y(t) = x(t)\cos(2\pi ft)$ [5]

Is the system: Linear ,time variant , stable.

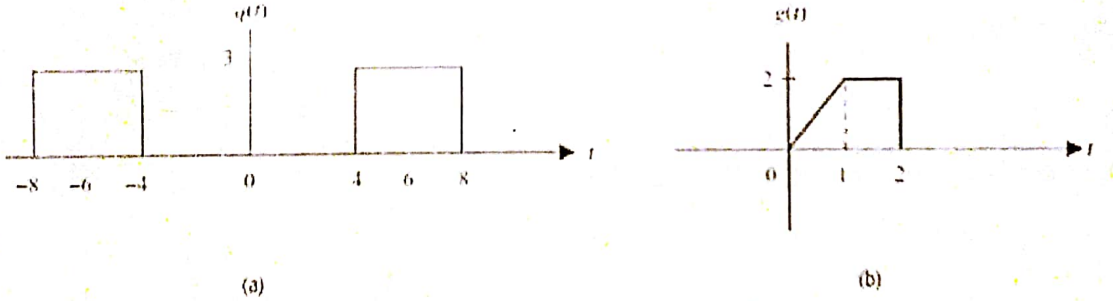


b- Using time domain analysis, find and sketch the step response of a circuit with the impulse response $h(t) = e^{-t}u(t)$. [8]

Q3) a-Compute and sketch the spectra of the first 5 components of the trigonometric Fourier series for the waveform shown below. [8]




b- Using tables of Fourier transforms and properties, Determine the Fourier transform of the following signals: [10]




(a) (b)

Q4) a-Compute the inverse Laplace Transforms of the following function: [5]

$$X(s) = \frac{s^2 + 5s + 6}{(s+4)(s+1)^2}$$

b- Find the frequency response H(s) and the impulse response h(t) of the RC circuit described by the equation $y' + 3y = x(t)$ where x(t) is the input and y(t) is the output ,then find the output y(t) if the input $x(t) = e^{-3t}u(t)$ , $y(0^-) = 0$ [10]

## Transformations' table:

| $x(t)$ | $X(\omega)$ | $X(S)$ |
|---|---|---|
| $\delta(t)$ | $1$ | $1$ |
| $1$ | $2\pi\delta(\omega)$ | …… |
| $sgn(t)$ | $\frac{2}{j\omega}$ | …… |
| $u(t)$ | $\pi\delta(\omega)+\frac{1}{j\omega}$ | $\frac{1}{s}$ |
| $e^{-at}u(t)$ | $\frac{1}{j\omega+a}$ | $\frac{1}{s+a}$ |
| $cos(\omega_0 t)$ | $\pi[\delta(\omega-\omega_0)+\delta(\omega+\omega_0)]$ | $\frac{s}{s^2+\omega_0^2}$ |
| $sin(\omega_0 t)$ | $\frac{\pi}{j}[\delta(\omega-\omega_0)-\delta(\omega+\omega_0)]$ | $\frac{\omega_0}{s^2+\omega_0^2}$ |
| $P_a(t)$ $=\begin{cases}A & \lvert t\rvert < a\\ 0 & \lvert t\rvert > a\end{cases}$ Pulse Duration=2a Or $2aA\,rect(\frac{t}{2a})$ | $2Aa\frac{\sin(\omega a)}{\omega a}$ | …… |
| $te^{-at}u(t)$ | $\frac{1}{(j\omega+a)^2}$ | $\frac{1}{(s+a)^2}$ |
| $t^n e^{-at}u(t)$ | $\frac{n!}{(j\omega+a)^{n+1}}$ | $\frac{n!}{(s+a)^{n+1}}$ |
| $e^{-a\lvert t\rvert}$ | $\frac{2a}{a^2+\omega^2}$ | …… |

## Properties' table:

| Property | TimeDomain | FourierDomain | LaplaceDomain |
|---|---|---|---|
| Time shifting | $x(t-t_0)$ | $e^{-j\omega t_0}X(\omega)$ | $e^{-st_0}X(s)$ |
| Frequency Shifting | $e^{j\omega_0 t}x(t)$or $e^{s_0 t}x(t)$ | $X(\omega-\omega_0)$ | $X(s-s_0)$ |
| Time differentiation | $\frac{dx}{dt}$ | $j\omega X(\omega)$ | $sX(s)-x(0^-)$ |
| Frequency differentiation | $-tx(t)$ | $-j\frac{dX}{d\omega}$ | $\frac{dX}{ds}$ |
| Duality | $X(t)$ | $2\pi X(-\omega)$ | …… |
| Time convolution | $x_1(t)*x_2(t)$ | $X_1(\omega)X_2(\omega)$ | $X_1(s)X_2(s)$ |



مع تمنياتي للجميع بالتوفيق والنجاح