Kaferelsheikh University
Faculty of Engineering
Department of Electrical Engineering
Year: Second
Subject: Signals Processing

Date: 04/07/2021
Time allowed: 3 Hours
Full Mark: 90 Marks
Final Exam: 2 Pages
Academic Number: ECE 2204

Answer the Following Questions

[1] Question One: Answer FOUR Points only (30 Marks)

a) Determine whether the following signals are energy signals, power signals, or neither.

(i) $x(t)=\begin{cases} e^{-at}, & 0<t<\infty, \quad a>0 \\ 0, & \text{otherwise} \end{cases}$, (ii) $x(t)=A\cos(\omega t+\theta)$

b) (i) Express $x(t)$ in Figure (1) in terms of the unit step function.
(ii) Sketch the derivative of $x(t)$.

c) Given $x(t)$ in Figure (2), sketch:
(i) $y(t)=-x(t-1)$, (ii) $z(t)=4x(t/2)$

d) Obtain the trigonometric Fourier series for the signal in Figure (3).

e) Determine the exponential Fourier series coefficients of the signal in Figure (4).

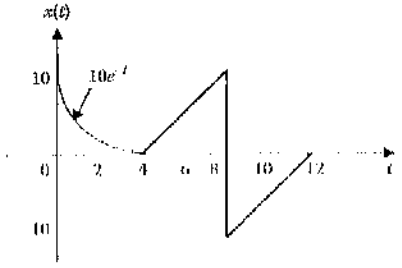

Figure (1)

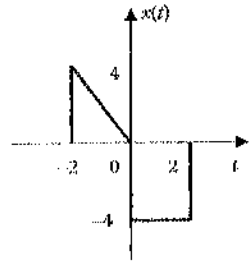

Figure (2)

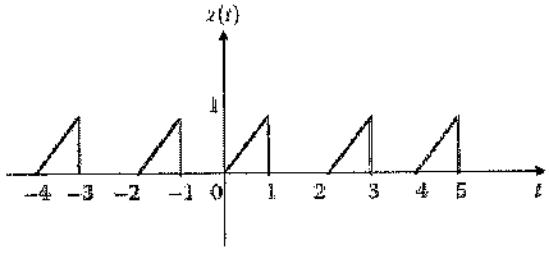

Figure (3)

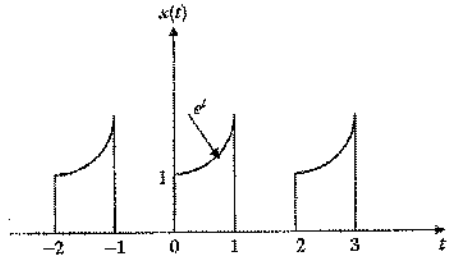

Figure (4)

[2] Question Two: Answer FOUR Points only (30 Marks)

a) Find the Fourier transform of the two-sided exponential pulse shown in Figure (5). Sketch the transform.

b) A signal has Fourier transform:

$$X(\omega)=\frac{5+j\omega}{-\omega^2+j2\omega+1}$$

Determine the Fourier transform of these signals:

(i) $y(t)=x(2t-5)$, (ii) $y(t)=\dfrac{d^2x(t)}{dt^2}$

c) If the Fourier transform of $u(t)$ is $\pi\delta(\omega)+1/j\omega$, prove that:

$$\mathcal{F}[\cos\omega_0 t\, u(t)] = \frac{\pi}{2}[\delta(\omega-\omega_0)+\delta(\omega+\omega_0)]+\frac{j\omega}{\omega_0^2-\omega^2}$$

d) Find the signal $x(t)$ corresponding to the spectral density function shown in Figure (6).

e) A band pass filter has its lower and upper cutoff frequencies as 10 and 20 Hz respectively. If the input signal is $V_i = 4e^{-t}u(t)$, calculate the $1-\Omega$ energy of the input and the percentage that appears at the output.

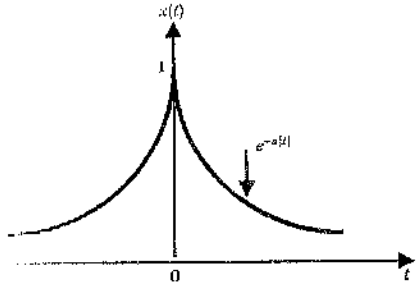

Figure (5)

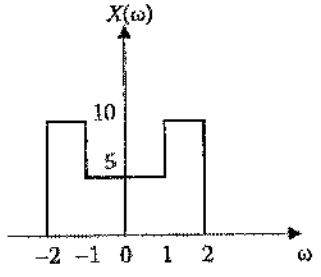

Figure (6)

[3] Question Three: Answer FOUR Points only (30 Marks)

a) Determine the z-transform and its ROC for:

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

b) Determine the z-transform of $y[n]=n^2a^n u[n]$.

c) Let the z-transform of a signal be:

$$X(z)=\frac{z-0.75}{z(z-1)(z+0.75)}$$

Find the initial and final values.

d) A discrete-time system is described by the difference equation:

$$y[n]-0.6y[n-1]-0.05y[n-2]=x[n]-x[n-1]$$

Find the impulse response.

e) Determine I_{out} and V_{out} in Figure (7) if the following binary strings are input at A_1 to A_8: (a) 1111 1111 and (b) 1010 1010.

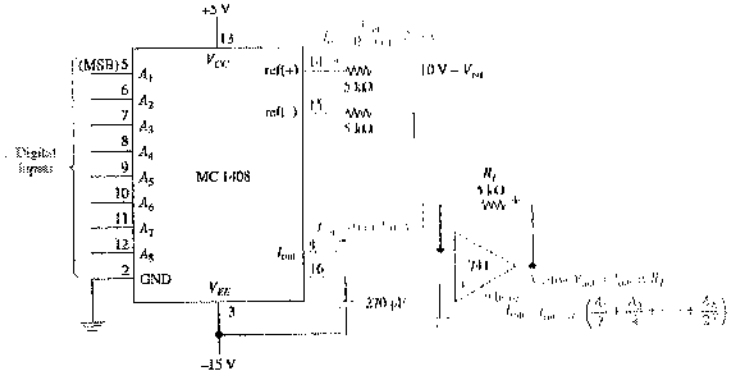

Figure (7)

Best Wishes
Dr. Emad A. Elshazly