AIR FORCE INSTITUTE OF TECHNOLOGY
ELECTRICAL/ELECTRONICS ENGINEERING AND INFORMATION & COMMUNICATION ENGINEERING DEPARTMENTS
SECOND SEMESTER EXAMINATION 2020/2021 SESSION
300 LEVEL

Course Title:	**SIGNALS AND SYSTEMS (EEE 316)**
Credit Unit:	**2 Units**
Instruction:	**ANSWER THREE QUESTIONS**
Duration:	**2 HOURS, 15 MINUTES**
Date:	**27 JAN 2022**

Question One

a. A complex exponential signal is given by the expression [6mks]

$x(t)=e^{(\sigma+j\omega)t}$

i. Using Euler's identity, express $x(t)$ as a sum of decaying sinusoids

ii. Given that $\sigma>0$, sketch the signal $x(t)$

b. Using appropriate sketches and mathematical expressions, describe the following signal types

ii. Unit impulse function

iii. Unit step function

iv. Unit ramp sequence [6mks]

c. Given that a discrete signal x[n]= {1, 0.5, 1, 2, 0.5, 0.5, 3, 4, 3}, sketch (7mks)

i. signal x[n]

ii. the decimated signal y[n] = x[2n]

d. Distinguish between the following [6mks]

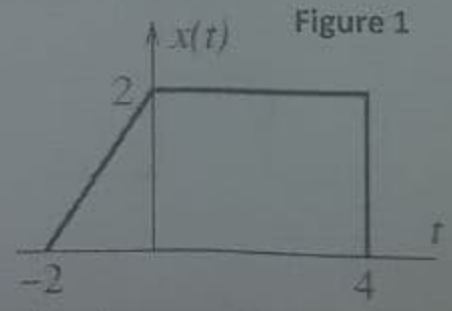
i. Linear and non-linear system

ii. Time-varying and time-invariant system

Question Two

a. Given signal x(t) in figure 1, decompose the signal into its even and odd components [8mks]

Figure 1



b. Briefly describe the following signal types [6mks]

i. Odd Signal

ii. Discrete-time signal

iii. Periodic signal

c. Determine algebraically whether the following signals are odd, even or neither [6mks]

i. $x(t) = 2t^3 - 4t$

ii. $x(t) = 2t^3 - 3t^2 - 4t + 4$

d. i. What do you understand by the term "system"? [2mks]

ii. What conditions must be satisfied for a system to be classified as Linear Time-invariant (LTI) (3mks)

Question Three

(a). Given that $x(t) = 1.5t, \quad 0 \leq t \leq 2$ and zero elsewhere. Sketch the following [7mks]

i. $x(t)$

ii. $f(t) = 1 + x(t-1)$

iii. $g(t) = x(1-t)$

b). State 2 major characteristics of each of the following signal types [6mks]

i. Even signal ii. Power Signal iii. Energy Signal

(c). Briefly describe the following classes of system [6mks]

a. causal system

b. memoryless system

c. feedback system

(d). Sketch the following signals [6mks]

i. $x(t) = u(t+3) - u(t-3)$

ii. $x[n] = u[n] - u[n-1]$

iii. $x[n] = \delta[n] + \delta[n-3]$

Question Four

4(ai) State two functions of Fourier series in signal analysis [4Marks]

4(aii) What is the condition that must be satisfied before using Fourier series to analyse signals? [2 Marks]

4(b) The input to the series RC circuit of Figure 4(bi) is the square waveform of Figure 4(bii). Compute the voltage $V_c(t)$ across the capacitor. Consider only the first three terms of the trigonometric Fourier series. For brevity assume that $\omega = 1$. [10 Marks]

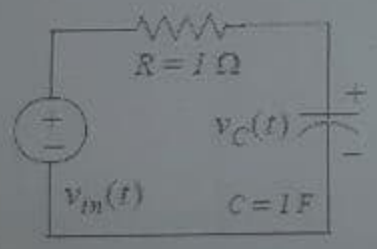


Figure 4(bi)

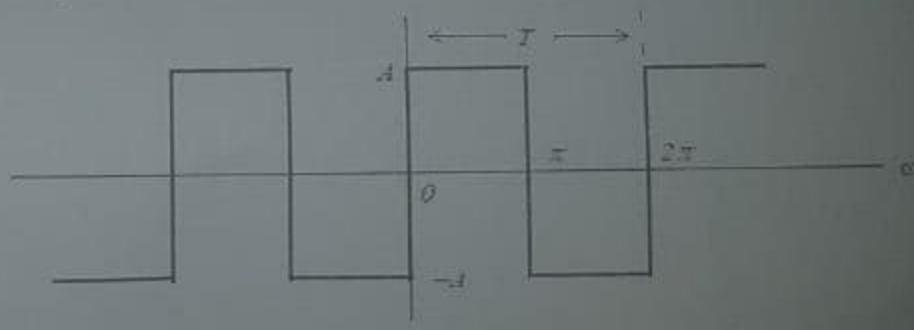


Figure 4(bii)

4(c) Derived the Fourier Transform of the pulse $f(t) = A[u_0(t) - u_0(t-2T)]$. The pulse is as shown in Figure 4(c). [5 Marks]

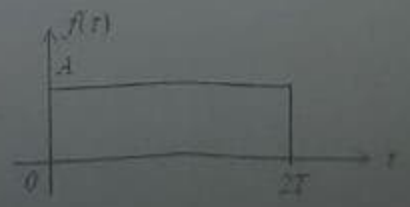


Figure 4(c)

4(d) Show that $f(t-t_0) \Leftrightarrow f(\omega)\ell^{-j\omega t_0}$ [4 Marks]

Question Five

5 (ai) In signal analysis, Fourier series are often expressed in exponential form rather than in trigonometric form. State the reason behind this. [2Marks]

(aii) State the importance of Laplace and Z-transforms to signal analysis. [4Marks]

(b) Find the first five components of the exponential Fourier series for the waveform of the Figure 5(b) shown below. Assume $\omega = 1$ [10 Marks]

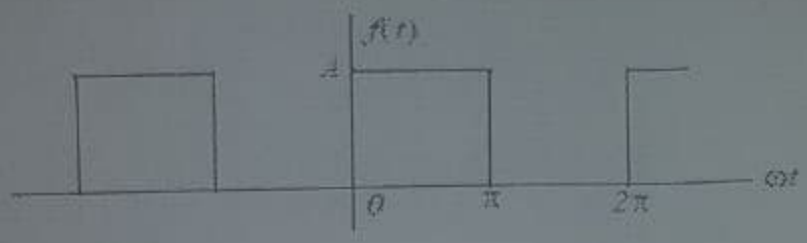


Figure 5(b)

5 (c) Derived the Fourier Transform of the pulse $f(t) = A[u_0(t+T) - u_0(t-T)]$ .The pulse is as shown in Figure 5(c). [4 Marks]

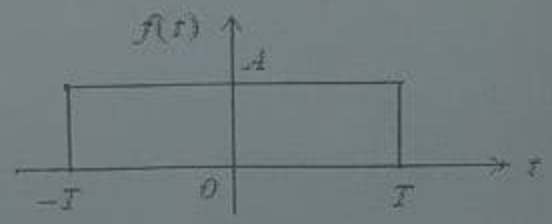


Figure 25(c)

5(d) State Parseval's Theorem [5 Marks]