IT204

SIGNALS AND SYSTEMS

ASSIGNMENT 3

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In [ ]:
```
#Question 1

# x(t) = A , -t1/2 < t < t1/2 and zero elsewhere
```

In [1]:
```
from sympy import *
import sympy as sp
import numpy as np
from numpy import *
A,t,t1,T,n,N = symbols('A,t,t1,T,n,N')
init_printing(pretty_print = True)
```

In [2]:
```
Integral (A**2,(t,-t1/2,t1/2))
```

Out[2]:
$$\int_{-\frac{t_1}{2}}^{\frac{t_1}{2}} A^2\, dt$$

In [3]:
```
Energy = integrate(A**2,(t,-t1/2,t1/2))
display('Energy of the signal E1 =', Energy)
E1 = Energy
```

```
'Energy of the signal E1 ='
```

$$A^2 t_1$$

In [4]:
```
Power = limit((Integral(A**2,(t,-t1/2,t1/2))/T),T,oo)
display('Power of the signal P1=',Power)
P1 = Power
```

```
'Power of the signal P1='
```

$$0$$

In [6]:
```
if E1 == oo and P1 != 0 and P1 != oo:
    display('x(t) is Power Signal')
if P1 == 0 and E1 != 0 and E1 != oo:
    display('x(t) is Energy Signal')
if E1 == oo and P1 != oo and P1 != 0:
    display('x(t) is Neither Energy Nor Power Signal')
if E1 == oo and P1 == oo:
    display('x(t) is Neither Energy Nor Power Signal')
if E1 == 0 and P1 == 0:
    display('x(t) is Neither Energy Nor Power Signal')
```

```
'x(t) is Energy Signal'
```

In [7]:
```
#Question 2

# x(t) = cos(t)
```

In [8]:
```
Integral((sp.cos(t)**2),(t,-oo,oo))
```

Out[8]:
$$\int_{-\infty}^{\infty} \cos^2(t)\, dt$$

In [9]:
```
Energy = integrate((sp.cos(t)**2),(t,-oo,oo))
display('Energy of the signal E2=', Energy)
E2 = Energy
```

```
'Energy of the signal E2='
```

$$\infty$$

In [10]:
```
Power = limit(integrate((sp.cos(t)**2)/T,(t,-T/2,T/2)),T,oo)
display('Power of the signal P2=',Power)
P2 = Power
```

```
'Power of the signal P2='
```

$$\frac{1}{2}$$

In [12]:
```
if E2 == oo and P2 != 0 and P2 != oo:
    display('x(t) is Power Signal')
if P2 == 0 and E2 != 0 and E2 != oo:
    display('x(t) is Energy Signal')
if E2 == oo and P2 != oo and P2 == 0:
    display('x(t) is Neither Energy Nor Power Signal')
if E2 == oo and P2 == oo:
    display('x(t) is Neither Energy Nor Power Signal')
if E2 == 0 and P2 == 0:
    display('x(t) is Neither Energy Nor Power Signal')
```

```
'x(t) is Power Signal'
```

In [13]:
```
# Question 3

# x(n) = (1/4)^n*U(n)
```

In [14]:
```
Energy = Sum(((1/4)**n)**2,(n,0,oo))
E3 = Energy.evalf()
```

In [15]:
```
display('Energy E3=', E3)
```

```
'Energy E3='
```

$$1.0$$

In [16]:
```
Power = Sum(((1/4)**n)**2,(n,0,N))/(2*N)
y = Power.doit()
Power1 = limit(y,N,oo)
P3 = Power1
display('Power P3=', P3)
```

```
'Power P3='
```

$$0$$

In [18]:
```
if E3 == oo and P3 != 0 and P3 != oo:
    display('x(t) is Power Signal')
if P3 == 0 and E3 != 0 and E3 != oo:
    display('x(t) is Energy Signal')
if E3 == oo and P3 != oo and P3 == 0:
    display('x(t) is Neither Energy Nor Power Signal')
if E3 == oo and P3 == oo:
    display('x(t) is Neither Energy NP Signal')
if E3 == 0 and P3 == 0:
    display('x(t) is NENP Signal')
```

```
'x(t) is Energy Signal'
```

In [19]:
```
# Question 4

# x(t) = t^(-0.5) U((t-2))
```

In [20]:
```
x = Integral(((t)**(-1/2))**2,(t,2,oo))
Energy = x
Energy
```

Out[20]:
$$\int_{2}^{\infty} t^{-1.0}\, dt$$

In [21]:
```
y = integrate(((t)**(-1/2))**2,(t,2,oo))
E4 = y
display('Energy E4=', y)
```

'Energy E4='

$$\infty$$

In [22]:
```
x1 = (1/T)*Integral(((t)**(-1/2))**2,(t,2,T/2))
x1
```

Out[22]:
$$\frac{\int_{2}^{\frac{T}{2}} t^{-1.0}\, dt}{T}$$

In [23]:
```
y1 = limit((1/T)*integrate(((t)**(-1/2))**2,(t,2,T/2)),T,oo)
display('Power P4=', y1)
P4 = y1
```

'Power P4='

$$0$$

In [24]:
```
if E4 == oo and P4 != 0 and P4 != oo:
    display('x(t) is Power Signal')
if P4 == 0 and E4 != 0 and E4 != oo:
    display('x(t) is Energy Signal')
if E4 == oo and P4 != oo and P4 == 0:
    display('x(t) is Neither Energy Nor Power Signal')
if E4 == oo and P4 == oo:
    display('x(t) is Neither Energy NP Signal')
if E4 == 0 and P4 == 0:
    display('x(t) is NENP Signal')
```

'x(t) is Neither Energy Nor Power Signal'

In [26]:
```
# Question 5

# Calculate the energy and power of the following problem.
# Classify the problem into one of the five categories mentioned
```

In [30]:
```
x1 = Integral((-4)**2,(t,0,2))
x2 = Integral((4)**2,(t,2,4))
x3 = Integral((4)**2,(t,4,6))
Energy = x1+x2+x3
Energy
```

Out[30]:
$$\int_{0}^{2} 16\, dt + \int_{2}^{4} 16\, dt + \int_{4}^{6} 16\, dt$$

In [31]:
```
y = integrate((-4)**2,(t,0,2)) + integrate((4)**2,(t,2,4)) + integrate((-4)**2,(t,4,6))
E5 = y
```

```
display('Energy E5=',y)
```

```
'Energy E5='
```

$$96$$

In [34]:
```
y2 = limit((1/T)*integrate((-4)**2,(t,0,2)),T,oo) + limit((1/T)*integrate((4)**2,(t,2,4)),T,oo) +
     limit((1/T)*integrate((-4)**2,(t,4,6)),T,oo)
display('Power P5=', y2)
P5 = y2
```

```
'Power P5='
```

$$0$$

In [35]:
```
if E5 == oo and P5 != 0 and P5 != oo:
    display('x(t) is Power Signal')
if P5 == 0 and E5 != 0 and E5 != oo:
    display('x(t) is Energy Signal')
if E5 == oo and P5 != oo and P5 == 0:
    display('x(t) is Neither Energy Nor Power Signal')
if E5 == oo and P5 == oo:
    display('x(t) is Neither Energy NP Signal')
if E5 == 0 and P5 == 0:
    display('x(t) is NENP Signal')
```

```
'x(t) is Energy Signal'
```

Sr. No.	Energy Output	Power Output	Category (Among the mentioned 5)
1	(A^2)*t1	0	Energy Signal
2	oo	0.5	Power Signal
3	1	0	Energy Signal
4	oo	0	Neither Energy Nor Power Signal
5	96	0	Energy Signal