SIGNALS & SYSTEMS

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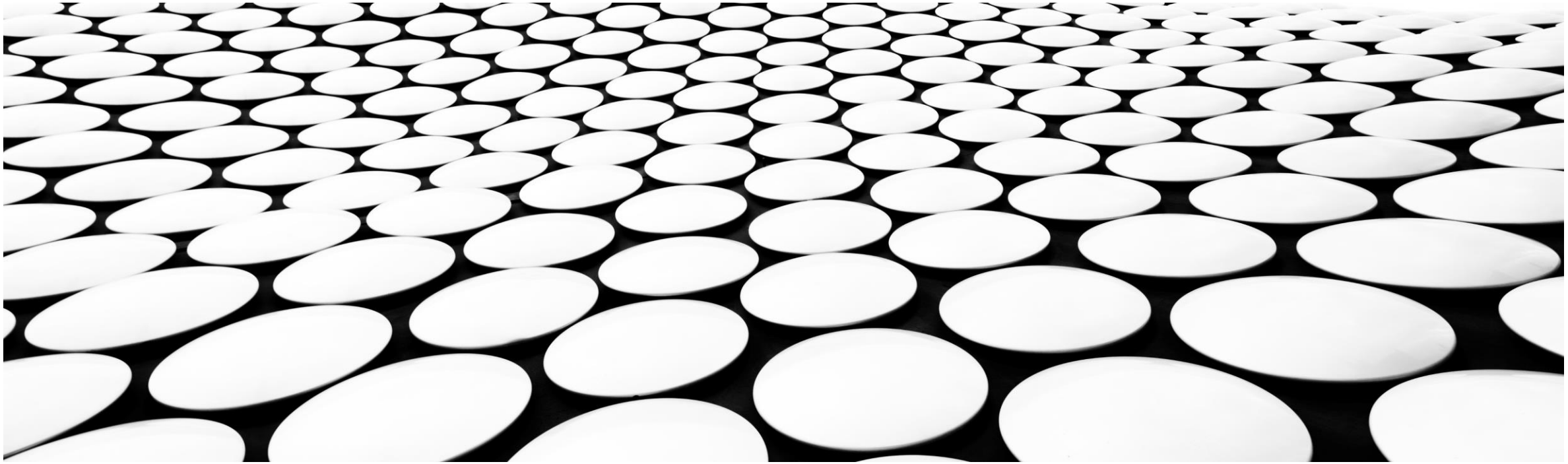
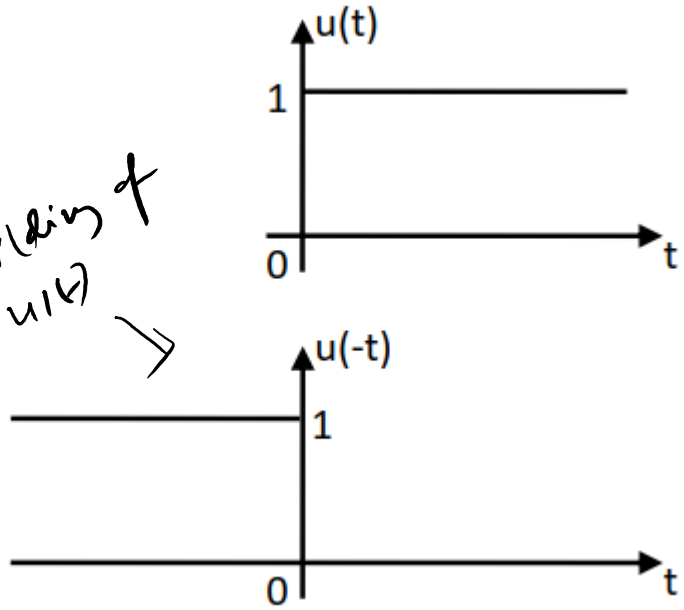


Sketch the following signals

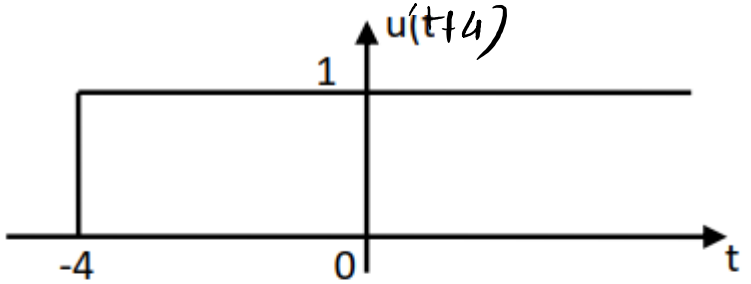
a) $x(t) = u(t+4)\,u(-t+4)$

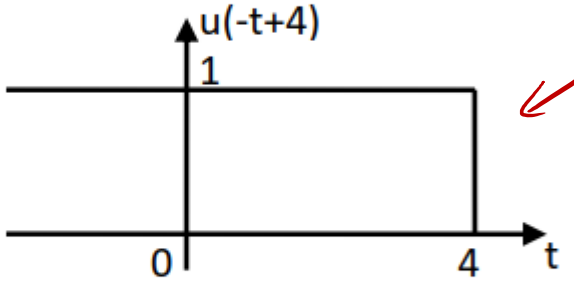
Always draw u(t)



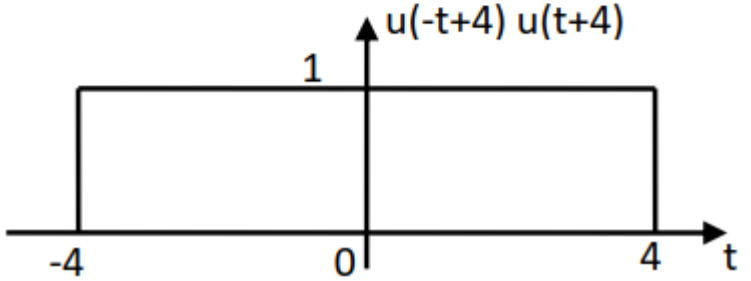
Folding of u(t)

Time shifting u(t+4) Advanced



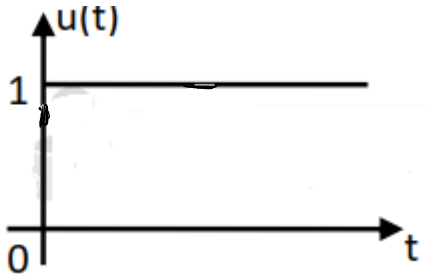


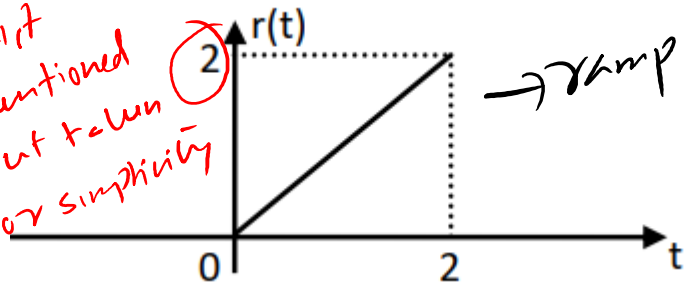
Time shifting u(-t+4) Delayed



b) x(t) = r(-t) u(t+2)

multiplication operation.

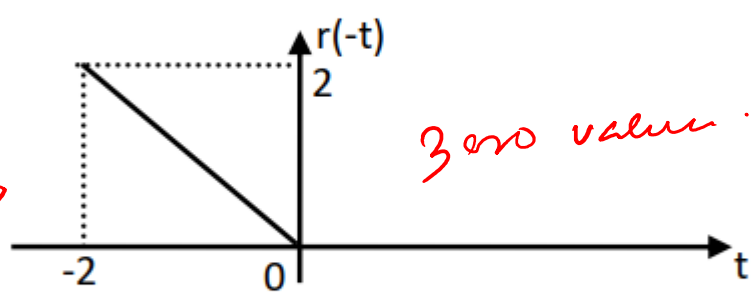




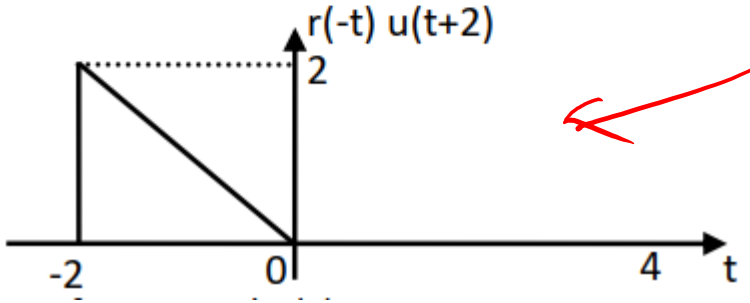
not mentioned but taken for simplicity

→ ramp signal

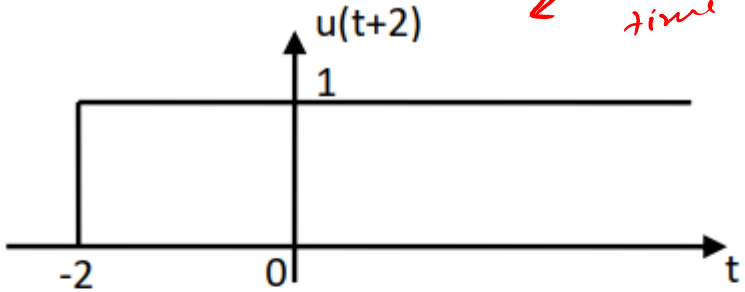
folding of r(t)



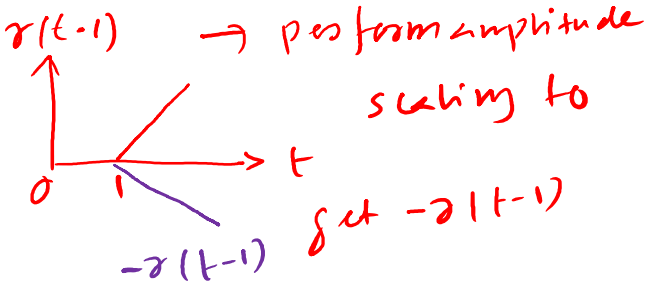
zero value.

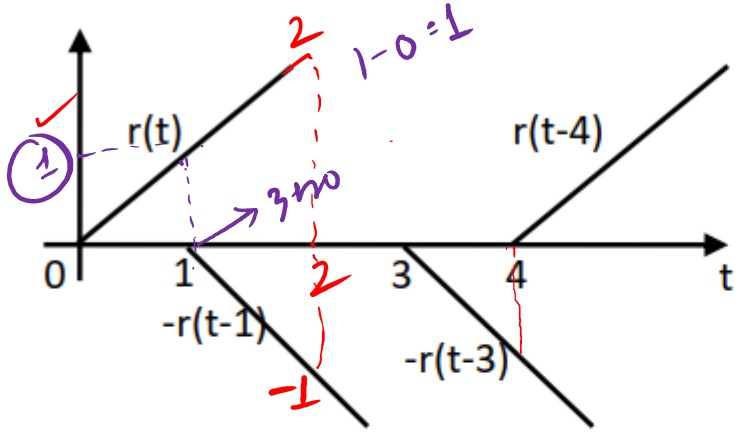


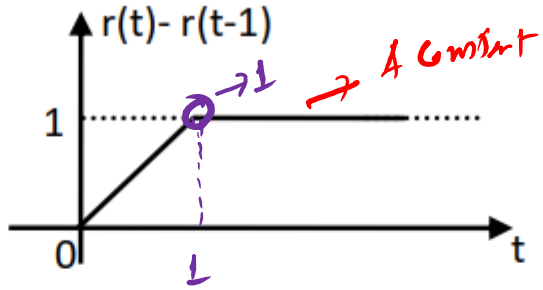
← Advanced signal time shifting by 2 units u(t+2)

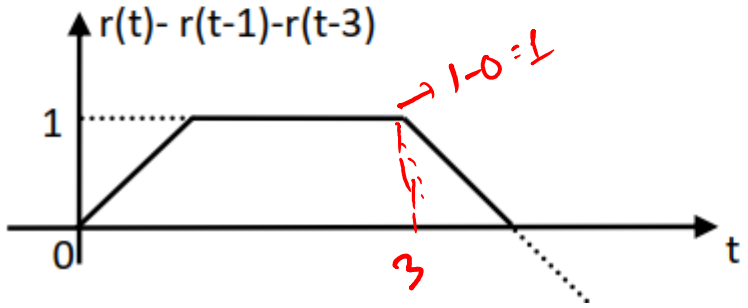


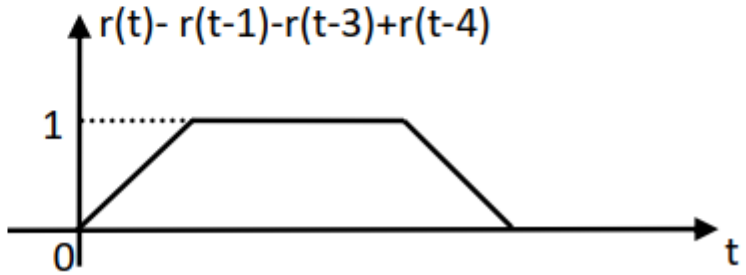
c) $x(t) = r(t) - r(t-1) - r(t-3) + r(t-4)$











Causal and Non-causal System : A system is said to be **causal** if its output $y(t)$ at any arbitrary time t_0 depends only on the values of its input $x(t)$ for $t \leq t0$. In the causal system the output does not begin before the input signal is applied. If the independent variable represents time, a system must be causal in order to be physically realizable. Noncausal systems can sometimes be useful in practice, however, as the independent variable need not always represent time.

Determine whether the following systems are causal or non-causal

(i) $y(t) = 0.2x(t) - x(t-1)$ (ii) $y(t) = 0.8x(t-1)$ (iii) $y(n) = x(n-1)$

(iv) $y(t) = x(t+1)$ (v) $y(n-2) = x(n)$ (vi) $y(n) = x(n) - x(n+1)$

Solution:

(i) Given that $y(t) = 0.2x(t) - x(t-1)$

In the above equation put t=0 then $y(0) = 0.2x(0) - x(-1)$

put t=1 then $y(1) = 0.2x(1) - x(0)$

Since the output y(t) depends on the present and the past input values of x(t), the system is **causal**

(ii) Given that $y(t) = 0.8x(t-1)$

In the above equation put t=0 then $y(0) = 0.8\,x(-1)$

put t=1 then $y(1) = 0.8\,x(0)$

Since the output y(t) depends on only the past input values of x(t), the system is **causal**

(iii) Given that $y(n) = x(n-1)$

In the above equation put n=0 then $y(0) = x(-1)$

put n=1 then $y(1) = x(0)$

Since the output y(n) depends on only the past input values of x(n), the system is **causal**

(iv) Given that $y(t) = x(t+1)$

In the above equation put t=0 then $y(0) = x(1)$

put t=1 then $y(1) = x(2)$

Since the output y(t) depends on future input values of x(t), the system is **non-causal**

(v) Given that $y(n-2) = x(n)$

In the above equation put n=0 then $y(-2) = x(0)$

put n=1 then $y(-1) = x(1)$

Since the output y(t) depends on future input values of x(t), the system is **non-causal**

(vi) Given that $y(n) = x(n) - x(n+1)$

In the above equation put n=0 then $y(0) = x(0) - x(1)$

put n=1 then $y(1) = x(1) - x(2)$

Since the output y(t) depends on the present and the future input values of x(t), the system is **non-causal**