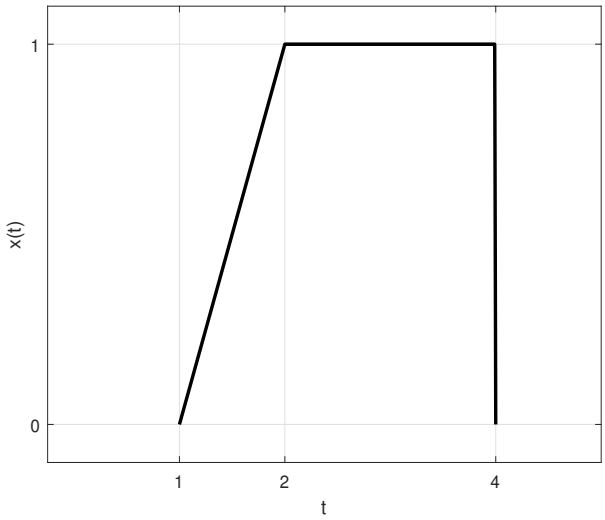
NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

Mid-semester Examination, March 2021

Subject Code: CS 207 | Subject Name: Signal & Data Communication
Semester: 4^{th} | Department of Computer Science & Engineering
Duration: 1 Hour | Total Marks: 20

All questions are compulsory. Each wrong answer carries -25% mark.

1. Consider the signal below. The signal is expressed by, [1 mark] [120 sec]



A. $(t+1)u(t)-(t+2)u(t-2)-u(t-4)$
B. $(t-1)u(t-1)-(t-2)u(t-2)-u(t-4)$
C. $tu(t-1)-u(t-2)-u(t-4)$
D. $(t-1)u(t+1)-(t-2)u(t-2)-u(t-4)$

2. The even component of $x(t) = \cos(40\pi t - \pi/4)$ is given by, [1 mark] [120 sec]

A. $\left(\frac{20}{\sqrt{2}}\right)\cos(40\pi t)$
B. $\left(\frac{20}{\sqrt{2}}\right)\cos(40\pi t - \pi/4)$
C. $10\cos(40\pi t)$
D. $10\cos(40\pi t - \pi/4)$

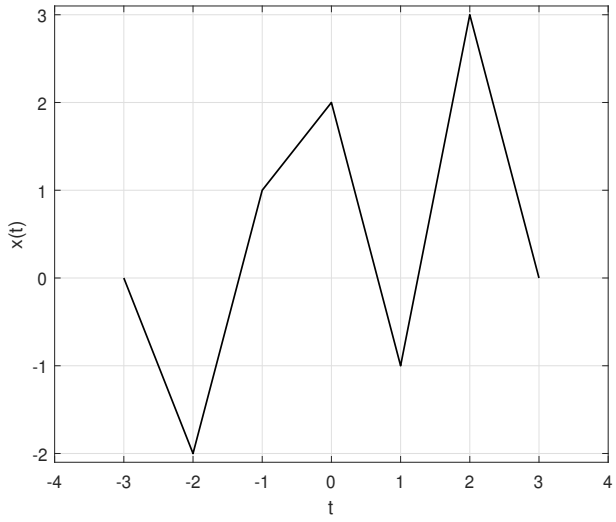
3. A signal is described by $x(t) = A\,\text{rect}(t) + B\,\text{rect}(t-0.5)$. Signal energy is, [1 mark] [120 sec]

A. $A+B$
B. $A-B$
C. A^2+B^2
D. $(A+B)^2$

4. Even and odd component of signal $x(t) = (1+t^3)\cos(10t)$ are, [1 mark] [120 sec]

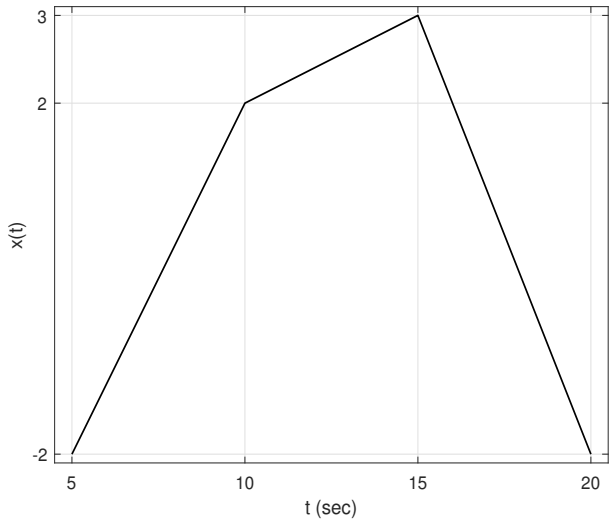
A. 0, $(1+t^3)\cos(10t)$
B. $t^3\cos(10t)$, $\cos(10t)$
C. $\cos(10t)$, $t^3\cos(10t)$
D. None of these

5. Consider the signal $x(t)$ given below. Suppose a new signal $f(t) = x\left(\frac{t-3}{4}\right)$ is defined. The value of the signal $\int_{-3}^{-1} f(t)dt$ will be, [1 mark] [180 sec]



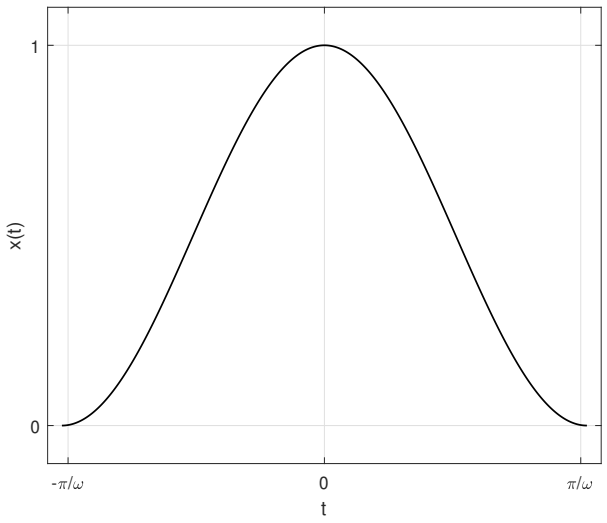
A. $-\frac{7}{2}$
B. $-\frac{3}{2}$
C. -2
D. -3

6. Consider the signal $x(t)$ given below whose one fundamental period is shown. The signal value at time $t = 220$ sec will be, [1 mark] [120 sec]



A. -2
B. 0
C. 2
D. 3

7. Consider the cosine signal depicted below. Total energy of the signal will be, [1 mark] [180 sec]



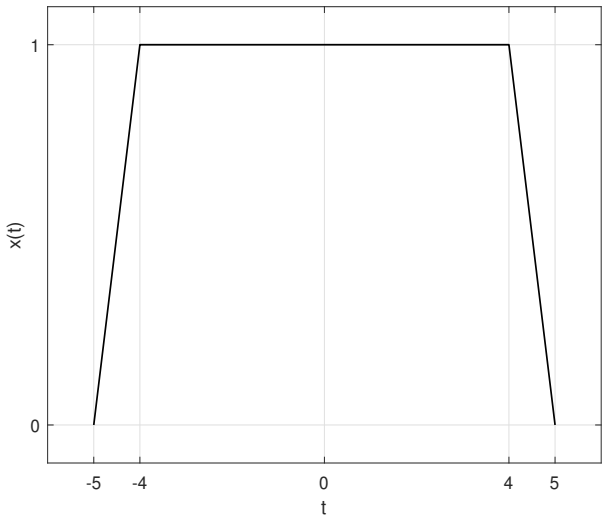
A. 3π

B. 4ω

C. $\frac{4\pi}{3\omega}$

D. $\frac{3\pi}{4\omega}$

8. Consider the signal depicted below which is applied to a differentiator. Total energy of the output signal of the differentiator will be, [2 marks] [240 sec]



A. 1

B. 2

C. ∞

D. None of these

9. The signal $x(t) = \cos(t)u(t)$ is, [1 mark] [120 sec]

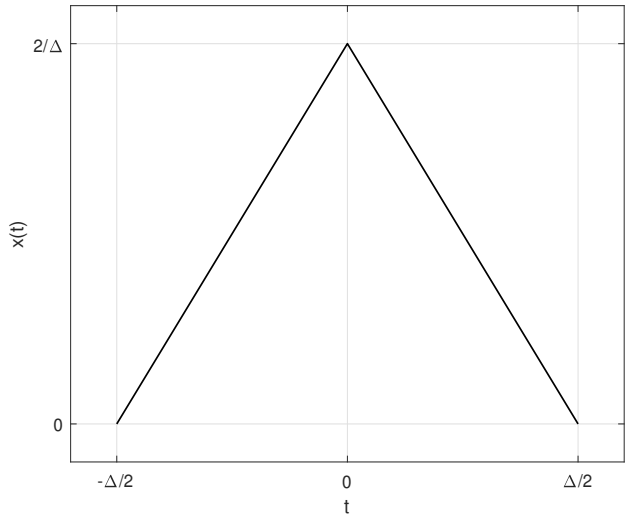
A. periodic, $T_0 = \frac{\pi}{2}$

B. periodic, $T_0 = \pi$

C. periodic, $T_0 = 2\pi$

D. Non-periodic

10. Consider the following signal which is applied to a differentiator. The output of the differentiator as $\Delta \to 0$ is, [2 marks] [180 sec]



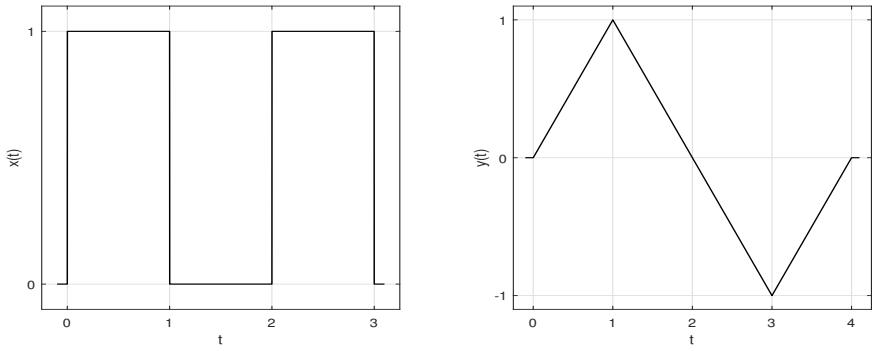
A. A positive impulse appear at $t = 0^-$.

B. A negative impulse appear at $t = 0^+$.

C. Both impulses appear.

D. None of these.

11. Consider the input ($x(t)$) & output ($y(t)$) signal of a LTI system below. The system is, [2 marks] [300 sec]



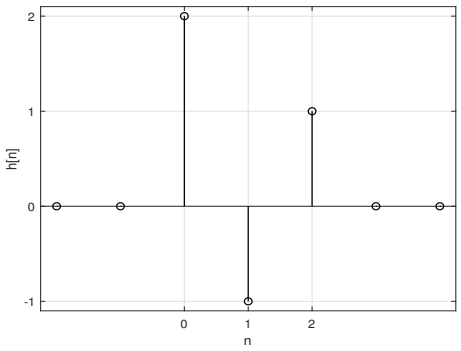
A. Memoryless & causal

B. Memoryless & non-causal

C. Non-memoryless & causal

D. Non-memoryless & non-causal

12. Consider the impulse response ($h[n]$) of a linear, time-invariant discrete system below. The system is subjected to input signal $x[n] = 2\delta[n] - \delta[n-2]$. System response will be, [2 marks] [300 sec]



A. $4\delta[n] - \delta[n-1] - \delta[n-3] + \delta[n-4]$
B. $4\delta[n] - \delta[n-1] - \delta[n-3]$
C. $2\delta[n] - \delta[n-1] + \delta[n-4]$
D. $4\delta[n] - 2\delta[n-1] + \delta[n-3] - \delta[n-4]$

13. A system is governed by the following equation. The system is, [1 mark] [240 sec]

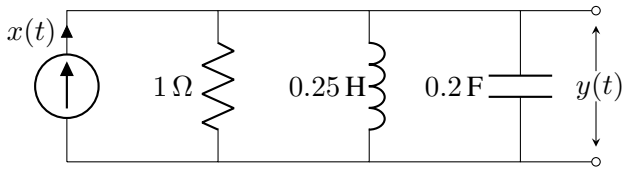
$$y(t)\frac{dx(t)}{dt} = x^2(t)$$

A. Homogeneous
B. Additive
C. Linear
D. None of these

14. The initial balance of a loan is Rs. 20,000 and the interest rate is 1% per month (12% per year). A monthly payment of Rs. 200 is made to the loan account at the start of each month. The loan balance after payment in each month will be, [2 marks] [360 sec]

A. increasing linearly
B. decreasing linearly
C. decreasing exponentially
D. will remain same

15. Consider the RLC circuit given below. Assuming some constants a, b, & c, the functional form of the unit step response, $y(t)$, of the circuit will be, [**Hint:** *current cannot change instantaneously through an inductor and voltage cannot change instantaneously across a capacitor.* Also, $x(t) = i_R(t) + i_L(t) + i_C(t)$] [3 marks] [900 sec]



A. $a\cos(ct)$
B. $a\sin(ct)$
C. $a\,e^{-bt}\cos(ct)$
D. $a\,e^{-bt}$ **sin**(ct)