EE 313 Signals and Systems Exam 1 Example

Name _____

Instructions: Show all work for full credit. Write answers in indicated places. Attach equation sheet to exam.

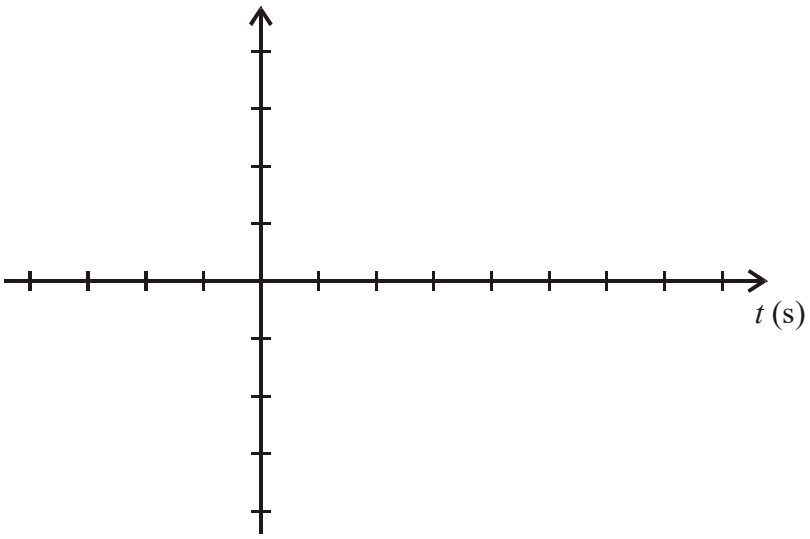
1) Using the forward-difference approximation, discretize the differential equation $\frac{d^2 y(t)}{dt^2} + 3\,y(t) = 0.5\frac{d\,x(t)}{dt} + 8\,x(t)$ given that $y(0) = 2$ and $\left.\frac{d\,y(t)}{dt}\right|_{t=0} = 20$ for a sampling period of $T =$ 0.24 s for $t \geq 0$. Put the resulting difference equation in the form $y[n] = -\sum_{i=1}^{N} a_i\,y[n-i] + \sum_{i=0}^{M} b_i\,x[n-i]$ and give the range of the index n for which it is valid. What is the order of the difference equation? What are the initial conditions $y[0]$ and $y[1]$?

$y[n]$ = **$2y[n-1] - 1.1728y[n-2] + 0.12x[n-1] + 0.3408x[n-2]$ $n \geq 2$**

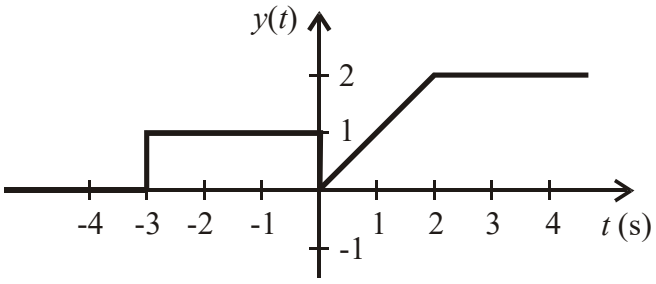
Order = **2** $y[0]$ = **2** $y[1]$ = **6.8**

2) Answer/solve the following questions.

a) Given $v(t) = -2u(t+2) + 4u(t-4) - 2u(t-6)$, plot $v(t)$.



b) Express the waveform $y(t)$ shown in terms of unit step functions and ramp functions.



$y(t) =$ ___***u(t + 3) - u(t) + r(t) - r(t-2)***_____

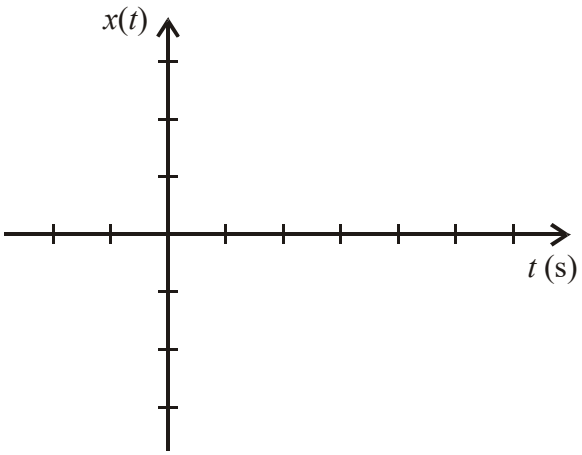
c) Given $x_1(t) = 12\cos(4\pi t)$ and $x_2(t) = 8\cos(0.2\pi t)$ is the sum $x_1(t) + x_2(t)$ periodic? **Yes** / No

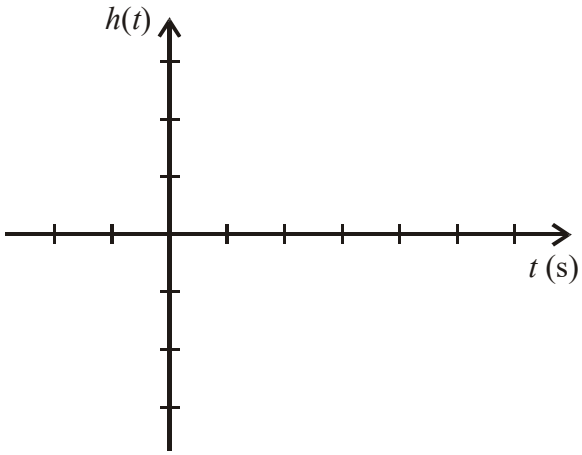
Why or why not?

d) Is the function $w[n] = 5\cos(4n - \pi/2)$ periodic? Yes / **No**

Why or why not?

3) The signal $x(t) = -2u(t-2)$ is input into a system containing no initial energy which is characterized by the impulse response $h(t) = 3e^{-0.5(t-1)}u(t-1)$. Accurately sketch $x(t)$ and $h(t)$ on the axes below. Then, calculate and accurately sketch the system output $y(t)$.





3) cont.

$$y(t) = \begin{cases} 0 & t < 3 \text{ s} \\ -12[1 - e^{-0.5(t-3)}] & t \geq 3 \text{ s} \end{cases}$$