

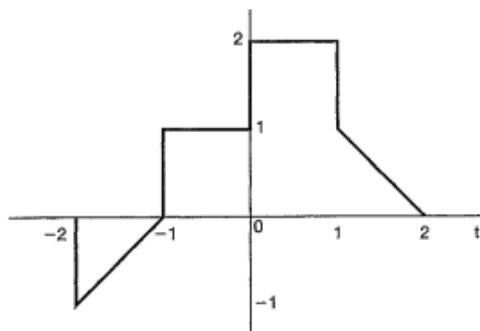
XMUT220 Signals and Systems

Homework 1 Answer all 7 questions, total = 22 marks.

Q1. [4 marks]

A continuous-time signal $x(t)$ is shown in the figure below. Sketch and label carefully each of the following signal.

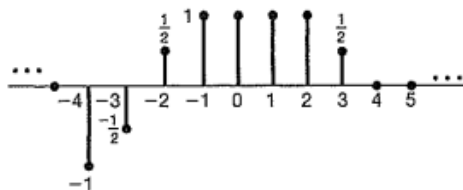
- a) $x(t - 1)$
- b) $x(2 - t)$
- c) $x(2t + 1)$
- d) $x(4 - t/2)$



Q2. [4 marks]

A discrete-time signal is shown in the figure below. Sketch and label carefully each of the following signals:

- a) $x[n - 4]$
- b) $x[3 - n]$
- c) $x[3n]$
- d) $x[n]u[3-n]$



Q3. [2 marks]

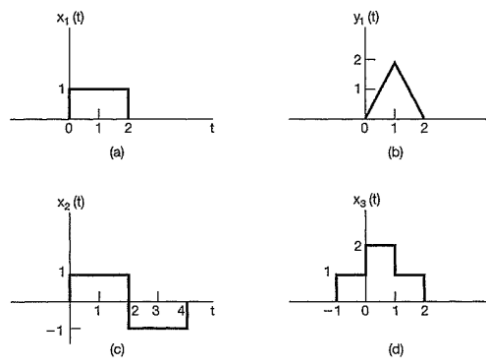
Determine whether or not each of the following continuous-time signals is periodic. If the signal is periodic, determine its fundamental period.

- a) $x(t) = 3 \cos(4t - \frac{\pi}{3})$
- b) $x(t) = e^{j(\pi t - 1)}$

Q4. [2 marks]

Here we illustrate one of the most important consequences of the properties of linearity and time invariance. Specifically, once we know the response of a linear system or a linear time-invariant (LTI) system to a single input or responses to several inputs, we can directly compute the responses to many other input signals.

- Consider an LTI system whose response to the signal $x_1(t)$ shown below is the signal $y_1(t)$. Determine and sketch carefully the response of the system to the input $x_2(t)$.
- Determine and sketch the response of the system in part (a) to the input $x_3(t)$.



Q5. [1 mark]

Compute the convolution $y[n] = x[n] * h[n]$ of the following pairs of signals:

- $x[n] = \alpha^n u[n]$, $h[n] = \beta^n u[n]$, $\alpha \neq \beta$

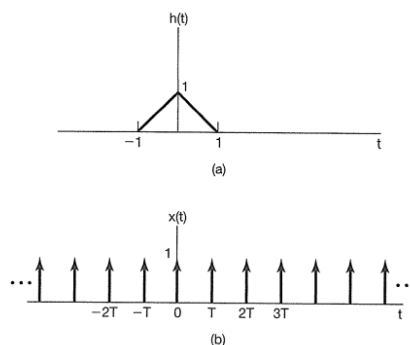
Q6. [4 marks]

Let $h(t)$ be the triangular pulse shown in Fig. (a) below, and $x(t)$ be the impulse train in Fig. (b), that is

$$x(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT).$$

Determine and sketch $y(t) = x(t) * h(t)$ for the following values of T

- $T = 4$
- $T = 2$
- $T = \frac{3}{2}$
- $T = 1$



Q7. [5 marks]

Determine whether or not each of the following discrete-time signals is periodic. If the signal is periodic, determine its fundamental period.

- (a) $x[n] = \sin(\frac{6\pi}{7}n + 1)$ (b) $x[n] = \cos(\frac{n}{8} - \pi)$ (c) $x[n] = \cos(\frac{\pi}{8}n^2)$
(d) $x[n] = \cos(\frac{\pi}{2}n)\cos(\frac{\pi}{4}n)$ (e) $x[n] = 2\cos(\frac{\pi}{4}n) + \sin(\frac{\pi}{8}n) - 2\cos(\frac{\pi}{2}n + \frac{\pi}{6})$