Note: All Questions carry equal marks.

① In Figure 1, the signal $f_1(t) = f(-t)$. Express the

signals $f_2(t)$, $f_3(t)$, $f_4(t)$ and $f_5(t)$ in terms of

signals $f(t)$, $f_1(t)$, and their time-shifted, time-scaled
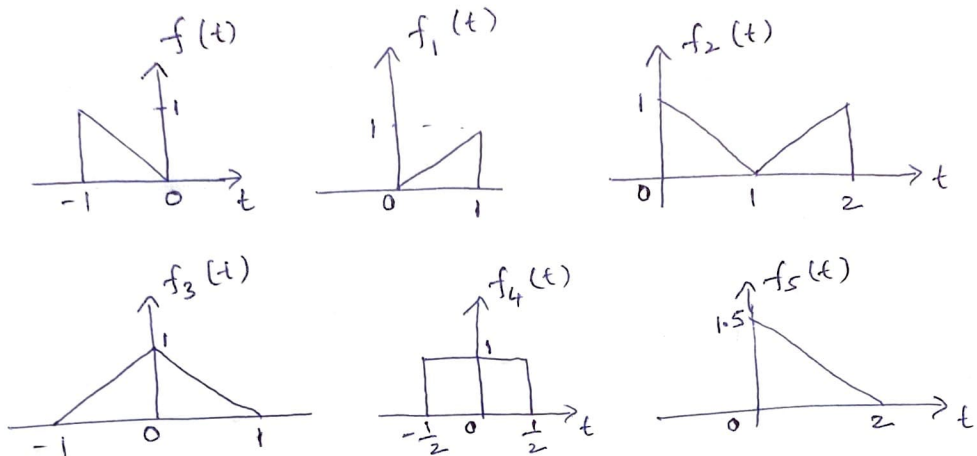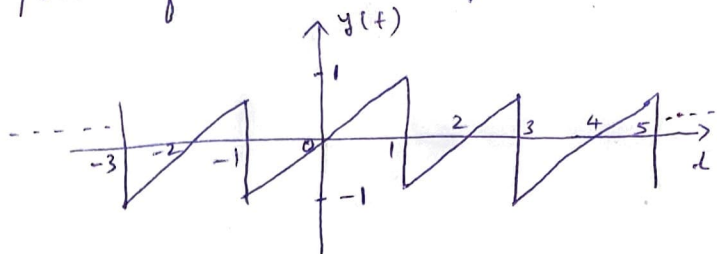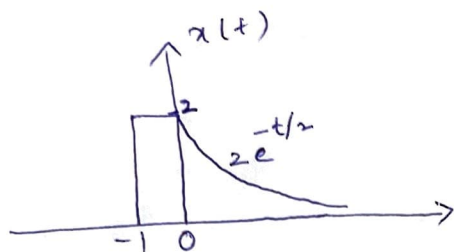
or time Inverted versions.

Figure 1

② Find the fundamental time period of the signal

$$f(t) = 1 + 2\cos(\pi t) + 3\sin\left(\frac{2\pi}{3} t\right) + 4\cos\left(\frac{\pi}{2} t + \frac{\pi}{4}\right)$$

③ Determine whether the system described by the

following equation is linear or not? Justify your

answer.

$$\frac{d^n y(t)}{dt^n} + a_{n-1}\frac{d^{n-1} y(t)}{dt^{n-1}} + \cdots + a_0 y = b_m \frac{d^m x(t)}{dt^m} + \cdots + b_1 \frac{dx(t)}{dt} + b_0 x(t)$$

The coefficients a_i and b_i in this equation can be

constants or functions of time.

④ → Find the energy and power of the following signals.

$x(t)$: shows value 2 between $t=-1$ and 0, then $2e^{-t/2}$ decaying for $t>0$.

$y(t)$: periodic sawtooth signal with markings at $-3, -2, -1, 0, 1, 2, 3, 4, 5$, amplitude between 1 and -1.

⑤ → Find the even and odd components of the following signal. Sketch them graphically.

$x(t)$: value 1 at $t=0$ decaying as e^{-at} for $t>0$.