

Chapter 2: Solutions to Exercise Problems:

E2.1: For the circuit in Fig. 2.10, the waveform of voltage is as shown in Fig. 2.11. Given that R is 10Ω , find power P supplied to the resistor. (A square-wave input)

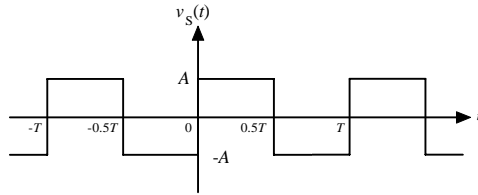


Fig. 2.11: A square-wave input signal

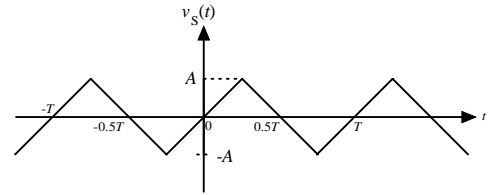


Fig. 2.12: A triangular-wave input signal

Solution:

For the square wave-input

$$P = \frac{1}{T} \int_0^T (v \cdot i) dt = \frac{1}{R \cdot T} \int_0^T v^2 dt = \frac{A^2}{R}$$

For the triangular-wave input

$$P = \frac{1}{R \cdot T} \int_0^T v^2 dt$$

$$\because v(t) = -v\left(t + \frac{T}{2}\right), \quad P = \frac{2}{R \cdot T} \int_0^{T/2} v^2 dt$$

$$\because v(t) = v\left(\frac{T}{2} - t\right) \text{ for } 0 < t < \frac{T}{4},$$

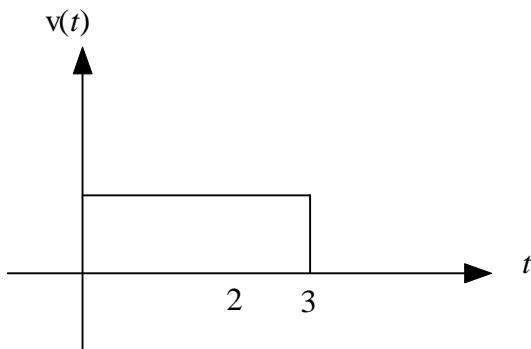
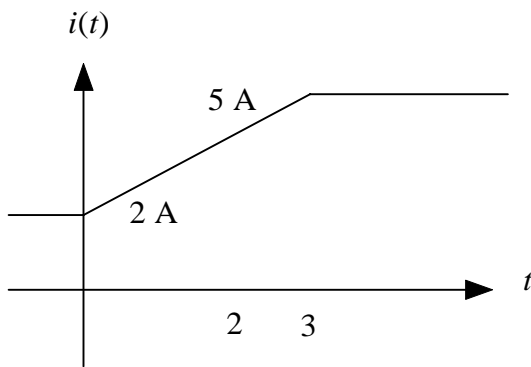
$$P = \frac{4}{R \cdot T} \int_0^{T/4} v^2 dt = \frac{4}{R \cdot T} \int_0^{T/4} \left(\frac{4A}{T}\right)^2 \cdot t^2 \cdot dt = \frac{A^2}{3R}$$

E.2.3: A 2 H inductor has an initial energy of 4 J at $t = 0$ second.. Its energy rises to 25 J in 3 seconds, with its current increasing linearly. After $t > 3$ s, the inductor current remains steady. Plot the waveform of inductor current and its voltage.

Solution:

$$i(t) = 2 + t, \quad \text{for } 0 < t < 3$$

$$v(t) = L \cdot \frac{di}{dt} = 2 \text{ Volt, for } 0 < t < 3 \text{ s}$$



E.2.4: A 3 F capacitor has zero initial energy at $t = 0$ second.. Its energy rises to 1536 J in 4 seconds, with its voltage increasing with square of time. After $t > 4$ s, the capacitor voltage remains steady. Get an expression for the capacitor voltage. Plot the waveform of capacitor voltage and its current.

Solution:

$$\frac{1}{2} C v^2 = 1536 \text{ J}$$

$$C = 3 \text{ F}$$

$$v(4) = 32 \text{ Volt}$$

$$v(t) = 2t^2 \text{ for } 0 < t < 4$$
$$= 32 \text{ for } t > 4$$

$$i(t) = C \frac{dv}{dt} = 12t \text{ for } 0 < t < 4$$
$$= 0 \text{ for } t > 4$$

