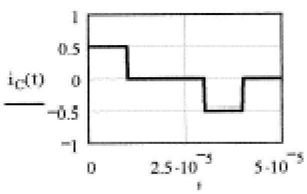
Homework Solutions 10

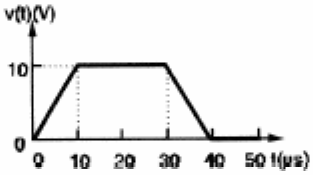
6-6 $C := 0.5 \cdot 10^{-6}$ $T_1 := 10 \cdot 10^{-6}$ $T_2 := 30 \cdot 10^{-6}$ $T_3 := 40 \cdot 10^{-6}$ $V_A := 10$ $B := \frac{V_A}{T_1}$

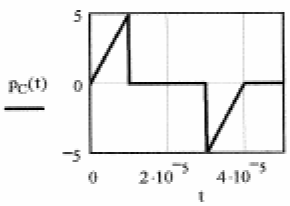
$v_C(t) := B \cdot (r(t) - r(t - T_1) - r(t - T_2) + r(t - T_3))$

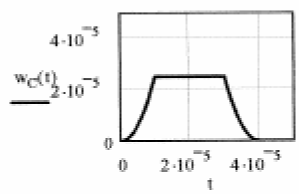
$i_C(t) := C \cdot B \cdot (u(t) - u(t - T_1) - u(t - T_2) + u(t - T_3))$ $B \cdot C = 0.5$ $t := 0, 0.0000002 .. 0.00005$

$p_C(t) := v_C(t) \cdot i_C(t)$ $w_C(t) := 0.5 \cdot C \cdot v_C(t)^2$







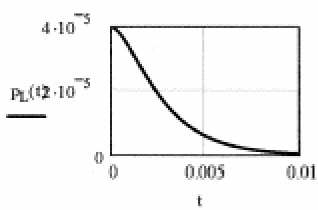


<--- $P_C(t)$ is positive and negative delivering and absrobing power.

6-17 $L := 200 \cdot 10^{-6}$ $i(t) = 40 \cdot 10^{-3} - 20 \cdot 10^{-3} \cdot \exp(-500 \cdot t$ $i_L(t) = -i(t) = -(40 \cdot 10^{-3} - 20 \cdot 10^{-3} \cdot \exp(-500 \cdot t)$

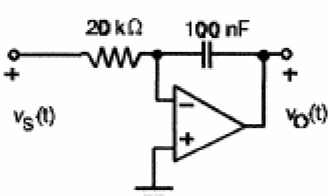
$v_L(t) = L \cdot \frac{d}{dt} i_L(t) = 200 \cdot 10^{-6} \cdot 20 \cdot 10^{-3} \cdot (-500) \cdot \exp(-500 \cdot t) = -2 \cdot 10^{-3} \cdot \exp(-500 \cdot t)$ $p_L(t) = v_L(t) \cdot i_L(t)$

$v_L(t) := -2 \cdot 10^{-3} \cdot \exp(-500 \cdot t)$ $p_L(t) := 80 \cdot 10^{-6} \cdot \exp(-500 \cdot t) - 40 \cdot 10^{-6} \cdot \exp(-1000 \cdot t)$ $t := 0, 0.00001 .. 0.01$



$p_L(t) > 0$ For t>0 the inductor is absorbing power

6-24 The circuit is an inverting integrator with $R := 20 \cdot 10^3$ $C := 100 \cdot 10^{-9}$ $R \cdot C = 2 \times 10^{-3}$



$v_O(t) = -10 - 500 \cdot \int_0^t 5 \, dx = -10 - 2500 \cdot t$

OP AMP saturates with v_O = -15 V

$v_O = -15$ $t := \frac{-15 + 10}{-2500}$ $t = 2 \times 10^{-3}$

6-29 The circuit is an inverting differentiator with $R := 100 \cdot 10^3$ $C := 10 \cdot 10^{-12}$ $R \cdot C = 1 \times 10^{-6}$

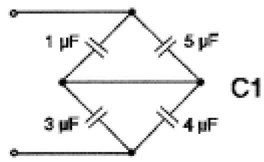
For $v_S(t) = 5 \cdot \exp(-\alpha \cdot t) \cdot u(t)$ in the linear range the output is

$|v_O(t)| = \left| -10^{-6} \frac{d}{dt} 5 \cdot \exp(-\alpha \cdot t) \right| = \left| 5 \cdot \alpha \cdot 10^{-6} \cdot \exp(-\alpha \cdot t) \right| < 15$ hence $|\alpha| < \frac{15}{5 \cdot 10^{-6}} = 3 \cdot 10^6$

6-36 For C!:

$$C_{EQ} := \left(\frac{1}{10^{-6} + 5 \cdot 10^{-6}} + \frac{1}{2 \cdot 10^{-6} + 4 \cdot 10^{-6}} \right)^{-1}$$

$$C_{EQ} = 3 \times 10^{-6} \quad \text{F}$$



For C2:

$$L_{EQ} := 10^{-3} + \left(\frac{2}{100 \cdot 10^{-6}} + \frac{1}{1.5 \cdot 10^{-3} + 2000 \cdot 10^{-6}} \right)^{-1}$$

$$L_{EQ} = 1.0493 \times 10^{-3} \quad \text{H}$$