ENGR 2910-101: Circuit Analysis

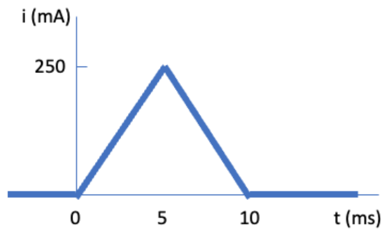
Instructor: Brian Rashap

Homework 7: 03/08/23

Due: 03/15/23

Question 1 [10]

The triangular pulse below is applied to a 20 mH inductor.



(a) Write the expressions that describe $i(t)$ in the four intervals:
$t < 0$, $0 \leq t \leq 5ms$, $5ms \leq t \leq 10ms$, $t > 10ms$.

(b) Derive the expressions for the inductor, voltege, power, and energy.

Question 2 [10]

The voltage across a $5\mu F$ capactior is know to be

$$v_o = 500te^{-2500t}V \text{ for } t \geq 0.$$

(a) Find the current through the capacitor for $t > 0$.

(b) Find the power at the terminals of the capacitor when $t = 100\mu s$.

(c) Is the capacitor absorbing or delivering power at $t = 100\mu s$.

Question 3 [10]

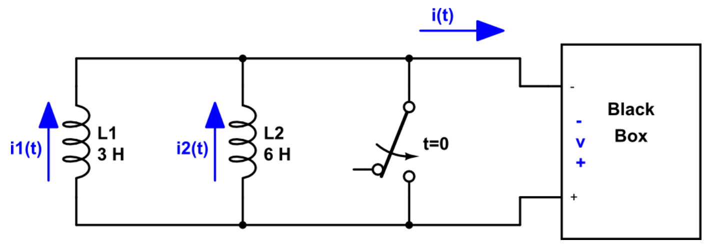
Two magnetically coupled coils are wound on a nonmagnetic core. The self-inductrance of coil 1 is $288mH$, the mutual inductance is $90mH$, the coefficient of coupling is 0.75, and the physical structure of the coils is such that $\mathcal{P}_{11} = \mathcal{P}_{22}$.

(a) Find L_2 and the turns ratio $\frac{N_1}{N_2}$.

(b) If $N_1 = 1200$, what is the value of $\mathcal{P}_1$ and $\mathcal{P}_2$?

Question 4 [10]

The two parallel inductors in the figure below are connected across the terminals of a black box at $t = 0$. The resulting voltage v for $t > 0$ is known to be $12e^{-t}V$. It is also known that $i_1(0) = 2A$ and $i_2(0) = 4A$.



(a) Replace the original inductors with an euivalent inductor and find $i(t)$ for $t \geq 0$.

(b) Find $i_1(t)$ for $t \geq 0$.

(c) Find $i_2(t)$ for $t \geq 0$.

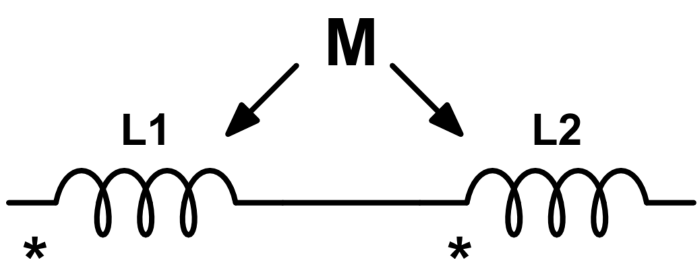
(d) How much energy is delivered to the black box in the time interval $0 \leq t \leq \infty$.

(e) How much energy was initially stored in the the parallel inducutors?

(f) How much energy is trapped in the ideal inductors?

(g) Show that your solutions for $i_1(t)$ and $i_2(t)$ agree with your answer in (f).

Question 5 [10]



(a) Show that the two copled coils above can be replaced by a single coil having an inductance of $L_{ab} = L_a + L_b + 2M$. (*Hint: express* v_{ab} *in terms of* i_{ab}.

(b) Show that if the connection to the terminals of the coil L_2 are reversed, then $L_{ab} = L_a + L_b - 2M$