EE1101: Circuits and Network Analysis

Assignment - 05

Handed out: 06 - Sep - 2024 **Due : 17 - Sep - 2024 (before 5 PM)**

Instructions :

1. Please upload your assignment solutions to the course page on the Canvas platform. Only solutions submitted through this page will be reviewed. For specific guidelines, refer to the instructions provided on the course page.
2. It is suggested that you attempt all the problems. However, it is sufficient to submit solutions for problems that total 10 points.
3. Submissions received after the deadline will attract negative marking. Ensure that your submissions are named in the following format: RollNo-Assignment-05.pdf.

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1. (5 points) Given the voltage $v(t)$ applied to an inductor as shown in Fig. 1, plot the current through the inductor, assuming it is zero at $t = 0$. Clearly highlight the peak values of the inductor current on your plot.

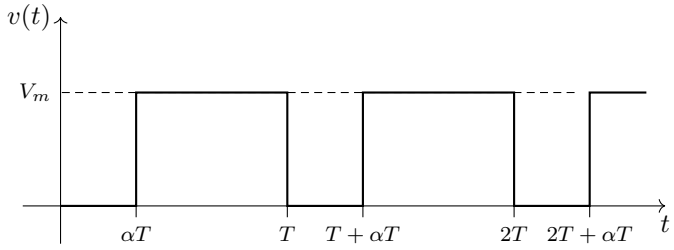

Fig. 1: Voltage applied across an inductor (Questions 1 - 4)

2. (5 points) Given the voltage $v(t)$ applied to an inductor as illustrated in Fig. 1, derive the expressions for the average and RMS values of both the applied voltage and the resulting inductor current (only if its periodic). If the inductor current is not periodic, compute the average value of inductor current from 0 to T and from T to $2T$.
3. (5 points) With the voltage $v(t)$ applied to an inductor as shown in Fig. 1, plot the instantaneous power of the inductor and, if it is periodic, calculate its average value.
4. (5 points) For the voltage $v(t)$ applied to an inductor as depicted in Fig. 1, derive an expression for the energy $e(t)$ stored in the inductor (for the first cycle).
5. (5 points) Given the current $i(t)$ through the capacitor as shown in Fig. 2, plot the capacitor voltage, assuming it is zero at $t = 0$. Clearly mark the peak values of the capacitor voltage on your plot.
6. (5 points) Given the current $i(t)$ through the capacitor as shown in Fig. 2, find the expressions for the average and RMS values of both the voltage across the capacitor (only if it is periodic) and the current through it. If the voltage is not periodic, compute the average value of capacitor voltage from 0 to T and from T to $2T$.

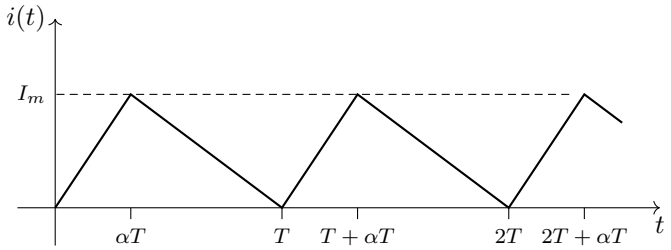

Fig. 2: Current through the Capacitor (Questions 5 - 8)

7. (5 points) With the current $i(t)$ through the capacitor as shown in Fig. 1, plot the instantaneous power of the capacitor and, if it is periodic, calculate its average value.

8. (5 points) For the current $i(t)$ through the capacitor as shown in Fig. 1, derive an expression for the energy $e(t)$ stored in the capacitor (for the first cycle).

9. (5 points) Consider the circuit shown in Fig. 3. Let Q_1 denote the reactive power of the inductor and Q_2 denote the reactive power of the capacitor. Calculate $Q_1 + Q_2$. Additionally, analyze how $Q_1 + Q_2$ will be affected if the frequency of the source is increased to twice its original value.

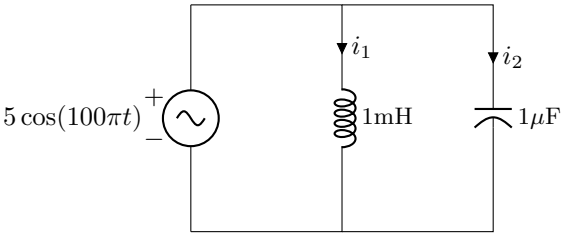

Fig. 3: Circuit fo question 9