Midterm Exam II

May 10, 2017

Rules and Regulations: It is permitted to bring two pieces of paper of A4 size with handwritten formulas. There is a time limit of two hours and fifty minutes.

Problems for Solution:

1. Please determine whether each of the following statements is *True* or *False*.

   (a) (4%) The total instantaneous power of a balanced three-phase circuit is constant.

   (b) (4%) The resonance frequency ω_0 can be obtained from the average of half-power frequencies ω_1 and ω_2 by

   $$\omega_0 = \frac{\omega_1 + \omega_2}{2}.$$

   (c) (4%) The instantaneous power for a load can be negative for some time t.

   (d) (4%) The average power P should be nonnegative.

   (e) (4%) The power factor angle $\theta > 0$ means the current lags the voltage.

2. (10%) Let the rms value of the voltage across a load impedance $\mathbf{Z}$ be V_{rms}. Show that the complex power absorbed by the load is

   $$\mathbf{S} = \frac{V_{rms}^2}{\mathbf{Z}^*}.$$

3. (10%) For a load impedance $\mathbf{Z} = R + jX$, the rms value of the voltage across the load is V_{rms}. Show that the average power absorbed by the load is

   $$P = \frac{V_{rms}^2}{R^2 + X^2} R.$$

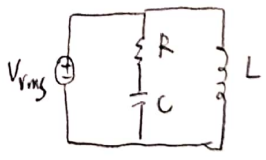
4. (10%) For a capacitive load, the frequency is ω and the rms value of voltage is V_{rms}. We know the average power is P. Determine the required inductance value L to change the power factor angle from θ_1 to θ_2 is

   $$L = \frac{V_{rms}^2}{\omega P(|\tan\theta_1| - |\tan\theta_2|)}$$

   or

   $$\frac{1}{L} = \frac{V_{rms}^2}{\omega P(|\tan\theta_1| - |\tan\theta_2|)}?$$

   You have to provide the proof.



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