ECE207 Elements of Electrical Engineering II

Test 1, Fall 2004

Name____________________________

Box #___________

For full credit, give units, properly use phasor notation and be neat and clear in your solution procedure.

Calculators and an 8½ x 11 sheet (both sides) permitted.

<table>
<thead>
<tr>
<th>question</th>
<th>possible points</th>
<th>awarded points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
1. The circuit below has its nodes labeled.
   
   i) Give the rms phasor circuit in the space provided given that all sources are 1591.5 Hz and
   \( v_a(t) = \sqrt{2}(50) \cos(\omega t + 30^\circ) \) V, \( v_b(t) = \sqrt{2}(25) \cos(\omega t - 30^\circ) \) V, \( i(t) = \sqrt{2}(5) \cos(\omega t + 60^\circ) \) A.

   ii) List the nodal equations needed to solve for all nodal voltages (DO NOT SOLVE)
2. A trace from an oscilloscope is shown below. The voltage channel was set on 20 V/cm, while the current channel was set on 200 mA/cm. The time-base was set at 2 msec/cm. Determine:
   i) Real power associated with the circuit.
   ii) Reactive power associated with the circuit.
   iii) Apparent power associated with the circuit.
   iv) Frequency (Hz) of the supply.
   v) Impedance of the circuit.

Oscilloscope Trace of Voltage & Current

![Oscilloscope Trace of Voltage & Current](image-url)
3. A single-phase load with an applied voltage of $v(t)$ and load current of $i(t)$, where:

$$v(t) = 5657 \cos(\omega t + 23.1^\circ) \text{ V}$$

$$i(t) = 1768 \cos(\omega t - 13.8^\circ) \text{ A}$$

is connected to a 60 Hz power system. Find:

i) Voltage and current phasors in terms of rms quantities

ii) Power triangle with - values of $P$, $Q$, $S$, and $\theta$ specified

iii) Capacitance ($\mu$F) of a capacitor to be connected in parallel with the load to improve the power factor to 0.95 lagging
4. For the system below, there are two loads connected in parallel. Find:

**Load 1**  \((3 + j4) \, \Omega\)

**Load 2**  \(30 \text{ kVAR} @ 0.8 \text{ lag}\)

i) \(I\)  (5 pts)

ii) \(S_{\text{load}}\)  (5 pts)

iii) \(\% \text{VR}\)  (5 pts)

iv) \(\% \eta\)  (5 pts)
5. Check all T/F statements either True or False (T/F) (2 pts each)

- Complete the phasor circuit above.
- The complex power delivered by the current source is \( S = V_i \left( \sqrt{2} \angle 30^\circ \text{ A} \right) \).
- The sum of the average power delivered by the sources must equal that absorbed by the resistance. Why or why not?

As C is increased from zero (s1 open) the power factor would increase which would lower \%VR and raise \%\( \eta \). Why or why not?

Closing s1 (C = 0) raises the load power factor and increases the power dissipated in both the load and in \( R_{\text{line}} \). Increasing \( L_L \) would lower the value of C required to correct the load pf to 1. For a given \( R_L \) and \( L_L \), increasing C from zero (s1 open) decreases the line current.

\( V_{\text{load}} = 100 \angle 36.87^\circ \text{ A} \).

The total average power delivered by the source is 160 W. Why or why not?

A power-factor-correction capacitor, \( C_{\text{pfc}} \), in parallel with the loads will increase the load pf, lower the \%VR, and increase the system \%\( \eta \). Why or why not?