ECE207 Elements of Electrical Engineering II

Test 2, 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.

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<tr>
<th>question</th>
<th>possible points</th>
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1. Given the system below, find
   
   i) the single phase equivalent circuit (10 pts)
   
   ii) \(\%n\) and \(\%VR\) (10 pts)

   ![Balanced 3\(^\circ\) System Diagram]

   \[Z_{line} = (1 + j2) \Omega\]

   per phase delta impedance
   \[Z_d = 200 \angle 36.9^\circ \Omega\]

   per phase wye impedance \((S_{14})\)
   \[100 \text{ W } @ \rho^* = 0.7071 \text{ lag}\]
2. A power distribution system is to be designed to deliver power to a 480 kW, 0.8 lagging power factor load. The load voltage is 600 V and the line impedance is 0.06 + j0.12 Ω. Calculate %VR and %η when

i) no transformers are used. (10 pts)

ii) two ideal transformers are used as shown below. (10 pts)
3. A toroid is made from material that has a relative permeability of 750. It has a square cross-section of 6 cm and a mean diameter of 40 cm, with an air-gap of 5 mm. Two coils are placed on the core. The first coil has 100 turns, a resistance of 5 Ω and is fed from a 250 V supply. The second coil has 679 turns and has a resistance of 6 Ω.

i) Determine the total MMF needed to produce a flux of 8 mWb in the air-gap.

ii) Determine the corresponding value of $V_2$ that has to be applied to coil 2.
   (NOTE: The MMFs of the 2 coils are additive).

iii) Determine the corresponding value of $V_2$ that has to be applied to coil 2, if its polarity is reversed and the MMFs of the 2 coils subtract.
4. A three-phase induction motor has the following information on its nameplate.

208 V, 60 Hz, 23 A, 0.82 lag, 8 hp, 684 rpm.

Determine:

i) # of poles and rated slip.

ii) Rated output torque.

iii) Rated efficiency.

iv) Rated air-gap power if the stator losses are constant at 200 W.

v) Rated mechanical power developed.

vi) Motor speed if the load is reduced to 60% of rated torque.
5. Mark each true/false question either T or F (2pts each)

___ The magnitude of $I_a$ is $24\sqrt{3}$ A

___ The power delivered to the load is 2304 W.

Why or why not?

___ $\%\eta = \left(\frac{4000}{42}\right)\%$

___ $V_x = 120\angle120^\circ$ V

___ In this model, decreasing $R_c$ will lower $\eta$ and have no affect on $V_R$.

Why or why not?

___ Decreasing R will lower both $\eta$ and $V_R$.

___ If N were doubled, $V_{dc}$ were doubled, R were halved, and $g_{gap}$ were doubled the magnet’s lifting ability would increase by a factor of 32.

___ The weight the electromagnet can lift increases as the square of the flux in the magnetic circuit.

Why or why not?

___ With each motor operating at rated conditions, a 100 hp, 1740 rpm motor will produce the same torque as a 50 hp, 870 rpm motor.

___ A 100 hp, 1140 rpm 3φ induction motor, when running at 1170 rpm is delivering 50 hp to its load.

Why or why not?