ECE207 Elements of Electrical Engineering II
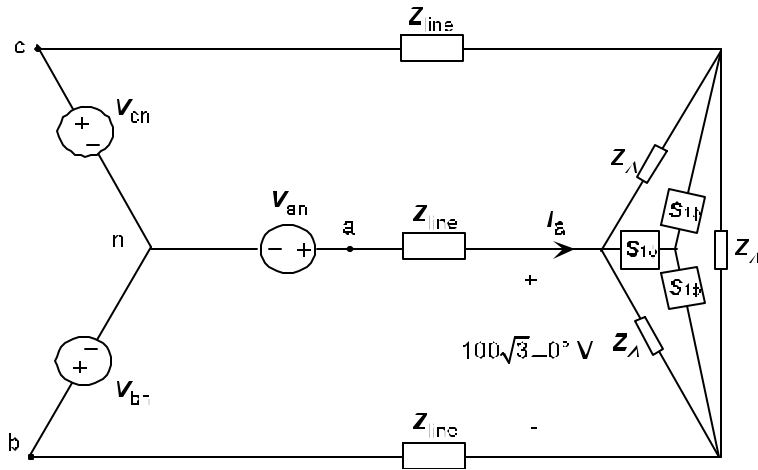
Test 2, Fall 2004

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.

question	possible points	awarded points
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

1. Given the system below, find

i) the single phase equivalent circuit (10 pts)
ii) %n and %VR (10 pts)

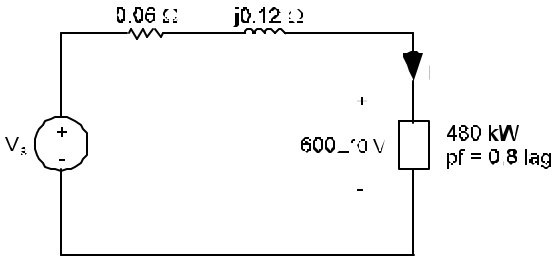balanced 3ϕ system

1. $Z_{line} = (1 + j2)\ \Omega$

2. per phase delta impedance
   $Z_\Delta = 200\angle 36.9°\ \Omega$

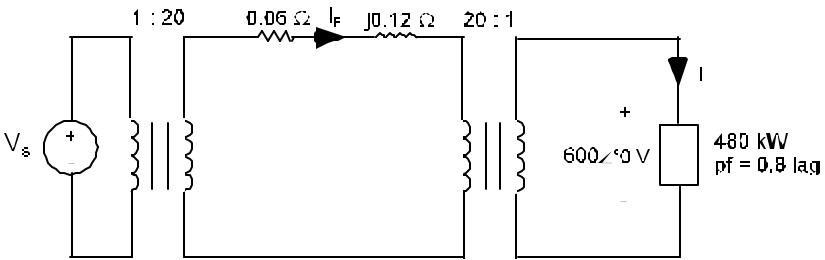3. per phase wye load ($S_{1\phi}$)
   100 W @ $p^f = 0.7071$ lag

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.
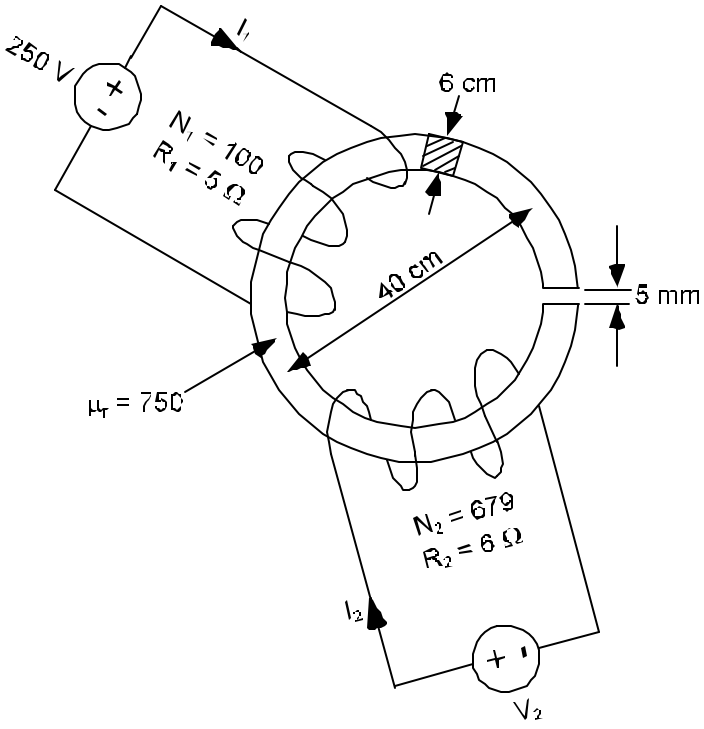
4. A three-phase induction motor has the following information on its nameplate.

   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.

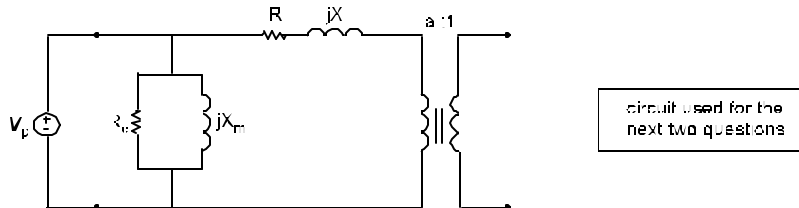5. Mark *each* true/false question either **T** OR **F** (2pts each)

Z = (4 − j3) Ω

circuit used for the first four questions

$120\sqrt{3}\angle 30°$ V
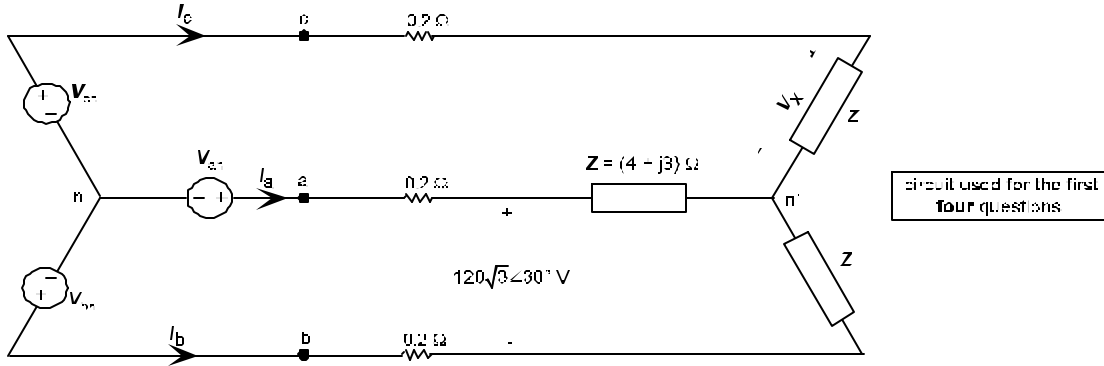
___ The magnitude of I_a is $24\sqrt{3}$ A

___ The power delivered to the load is 2304 W.
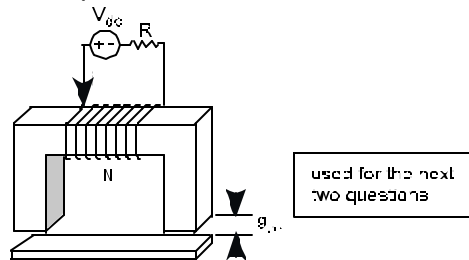*Why or why not?* _____
_____

___ %$h = \left(\dfrac{4000}{42}\right)$%

___ $V_x = 120\angle 120°$ V

circuit used for the next two questions

___ In this model, decreasing R_c will lower η and have no affect on VR.
Why or why not? _____
_____

___ Decreasing R will lower both η and VR.

used for the next two questions

___ 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? _____
_____

Test 2