ECE471 INDUSTRIAL POWER SYSTEMS

Test # 1, Winter 2004 - 2005

Name_____

Box #_____

Attempt all five questions.
No partial credit unless you explain your solution procedure.
Write in the space below the question, and on the page facing the question.

Open Notes. Time Allowed - Two Periods.

Question #	Possible Points	Awarded Points
1	**20**	
2	**20**	
3	**20**	
4	**20**	
5	**20**	
Total	**100**	

1.

A three-phase Δ-connected load is rated 45 kVA, 208 V, 0.75 lag pf.

a) What is the smallest gauge of copper conductor that should be used based on type THWN insulation? (Assume the raceway is in free air).

b) How many kVAR of compensation is required to improve the pf to 0.95 lag?

c) What is the smallest gauge of conductor that could be used with the improved pf?

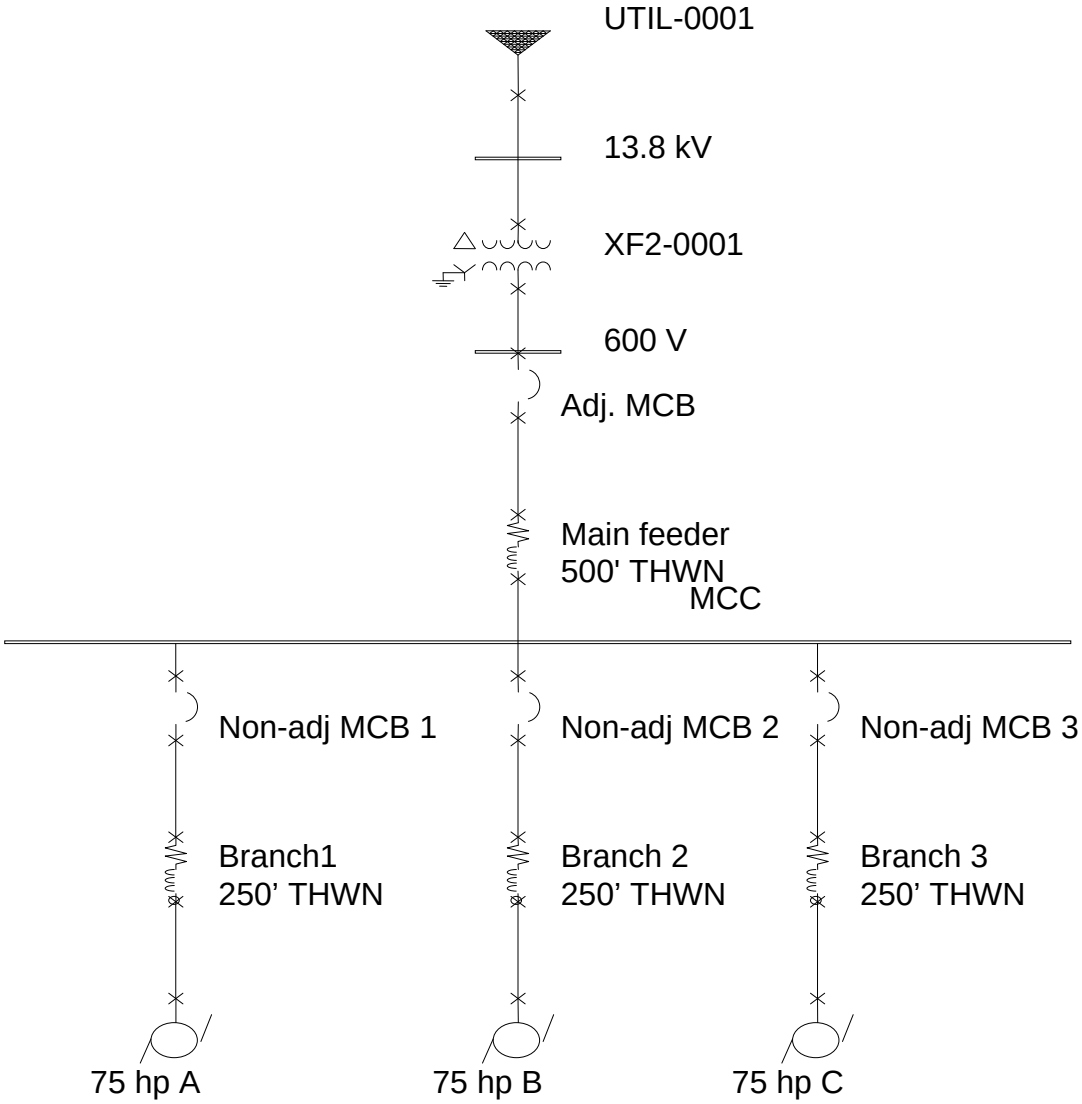
a) 2/0

b) 18.67 kVAR

c) #1

2.

In the system shown below the cables are copper conductor with THWN insulation rated for 75^0C. The assumptions made for NEC 430-150 (Table 13.2) apply.



a) Determine the frame size and trip rating of all MCBs shown above.

b) Use Tables 11.1 and 13.2 to determine the gauge of each feeder and branch (based on continuous current loading). The motors are delta and will not require a neutral conductor.

c) Will the NEC voltage regulation criteria be met for the feeders and branches you have proposed in part (b)? Determine the margin of compliance (violation) using Table 11.5. Each branch is 250' long and will use copper conductors with THWN insulation.

a)
Each 75 hp motor draws 77A, so each branch ampacity has to be 96.25 A.
This requires 150 Std with 90A trip.

Feeder ampacity is 250.3A. This requires 400 Std with 250A trip.

b)
Branches require #3 Cu. Feeder requires 250 MCM Cu.

c)
From table 11.5, #3 Cu gives 0.231 V/kAft (80% pf). So branch VR is 1.28%.
Likewise, 250 MCM Cu gives 0.07 V/kAft (80% pf). So feeder VR is 2.33%.
The overall VR is OK by 1.38%.

3.

a) Refer to figure 8.7 in your textbook. For a molded-case breaker with 150 A frame and 150 A trip unit, determine the minimum and maximum operating times for a current of 300 A.

b) What are the minimum and maximum currents that will initiate instantaneous tripping on the breaker in part (a)?

a) t_{min} = 80 s, t_{max} = 250 s.

b) I_{min} = 787.5 A, I_{max} = 2250 A.

4.

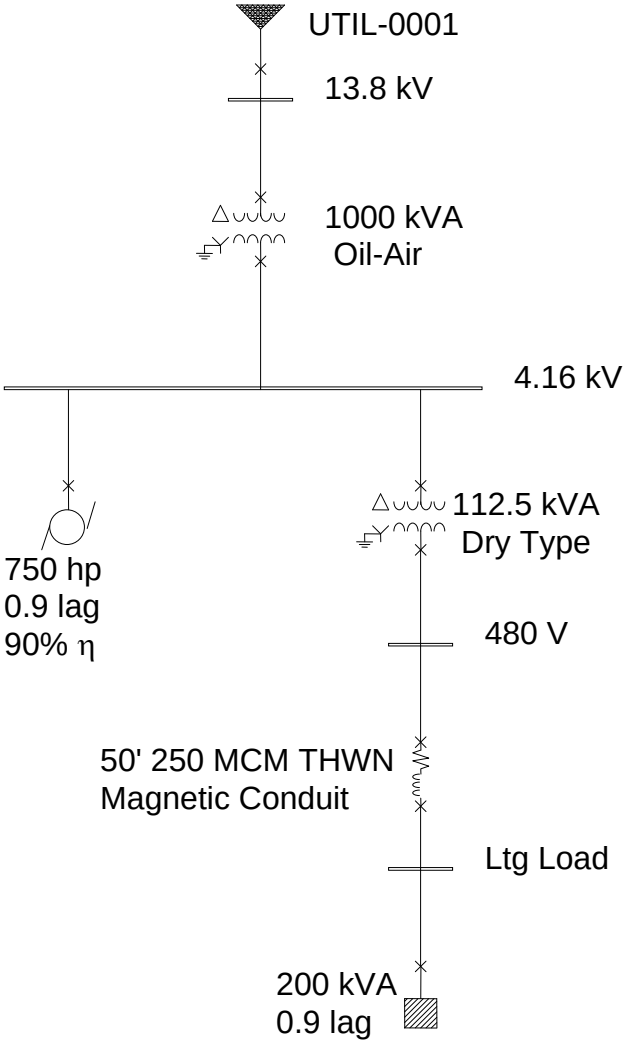
Part of a three-phase industrial installation is shown below.

a) Input this into the PTW software, run the load flow.

b) Enter all bus voltages on the circuit diagram below.

c) What are the total system losses in kW and kVAR?

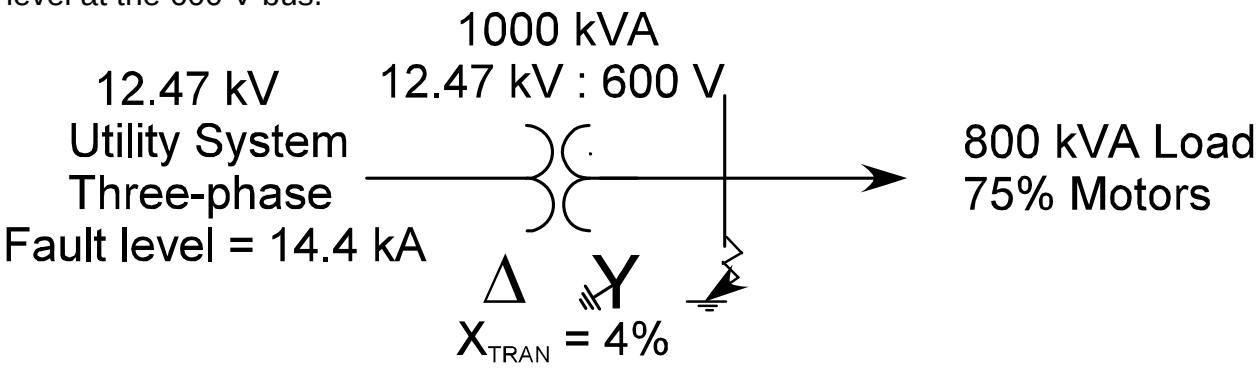
The source is 13.8 kV with a three-phase fault level of 10 kA and a single-phase fault level of 5 kA. The main transformer is 1000 kVA oil air (1.15 load factor), with impedance 1.0 + j5.66 %, while the lighting transformer is 112.5 kVA dry type (load factor 1.0), with impedance 2.56 + j3.69 %. The cable is 3-1/C+G, 250 MCM, THWN. (Note that you do not need to enter protection devices to run load flow.)



c) Total System Losses = 21 kW + j70 kVAR

5.

For the system shown below, determine the balanced, bolted three-phase fault level at the 600 V bus.



Total fault current = 24.58 kA.