

Exam #1

Spring 1998

1. Closed book, closed notes, no sheet, 55 minutes
2. Work all problems on exam booklet provided
3. Use full equations: $1 \text{ HP} = 746 \text{ Watts}$, $\bar{V} = \bar{Z} \bar{I}$
 $\bar{S} = \bar{V} \bar{I}^*$, $T = P/\omega$, $S = \frac{\omega_s - \omega}{\omega_s}$, $\text{RPM}_{\text{sync}} = \frac{120f}{p}$

Problem #1
24 points

Given a single-phase source of $2,400 \angle 0^\circ \text{ V}$ (Rms), with 3 loads in parallel:

Motor: 100 kW at $\text{Pf} = 0.9$ lag

Lights: 100 kW at $\text{Pf} = 1.0$

Capacitors: 100 kVAR at $\text{Pf} = 0$ lead

- Find:
- (a) $\bar{S}_{\text{total}}$ provided by the source
 - (b) $|\bar{I}|_{\text{source}}$
 - (c) Pf of the total load

Problem #2
24 points

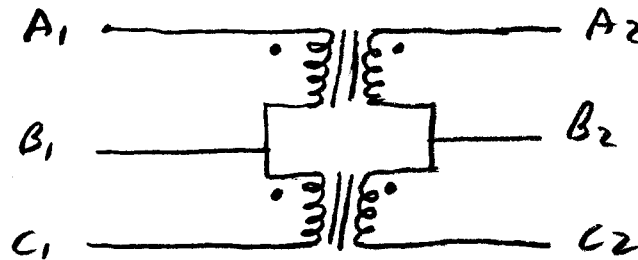
Given a balanced 3ϕ , 60 Hz source with $V_{\text{LL}} = 480 \text{ V}$ (Rms) serves a load of 4500 VA at $\text{Pf} = 0.8$ lag.

- Find:
- (a) I_{line}
 - (b) the value of C which should be connected in a delta to minimize I_{line}
 - (c) I_{line} when C from (b) is in

Problem #3
26 Points

Balanced 3 ϕ , 3w
ABC sequence
source

Given the "open-delta" connection:



Open
Circuit

- 10(a) If the rating of each transformer is 50 kVA, what is the 3 ϕ rating of this bank?
- 16(b) If the two transformers are identical and saturated, describe the 3 line currents on the "1" side and the voltages on the "2" side.

Problem #4
26 Points

An induction motor nameplate says: 5 HP, 60 Hz, 6 pole, 230V, 3 ϕ , full-load speed 1080 RPM

- 6(a) What is the frequency of the rotor current at full load?
- 6(b) What is the torque to the shaft at full load?
- 14(c) Estimate the value of r_2'
(Rotor resistance per phase referred to the stator)