ECE 320: Lecture 17

Notes

- Reminder: Exam 1 will be next Friday, October 10. Possibility of an early exam on Thursday, but I will only set one time.
  * If you are interested in the early exam, tell me, and also state when you are able to take it on Thursday.
  * Topics: Everything covered through today's lecture.
  * Lecture summaries of all lectures will be posted next week
  * I will try to post a sample exam and solution.

- Lab changes: The lab groups are a bit too large, with 4-5 per group, so not everyone actually wires the circuits. Starting with next weeks labs we will divide each lab section in half. One ha (one of the present lab groups) will do the lab next week. The other half will do the lab the following week. The lab groups will then be 2 or 3.
  * The group not meeting in a given week will have recitation.
  * We will run out of weeks, so there will be a lab or possibly two where the full sections w meet together again, but at least one of those will be a lab where we can have 4 lab stations.

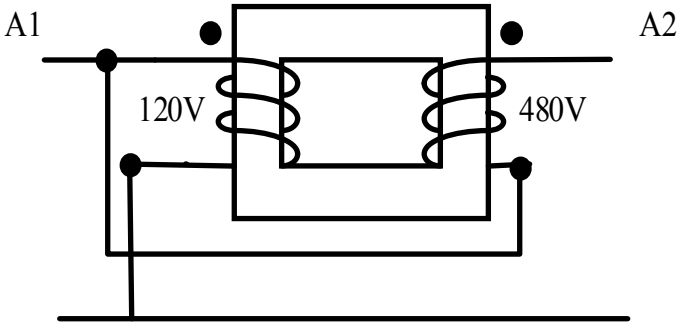
- Questions from the last several lectures on magnetic circuits?

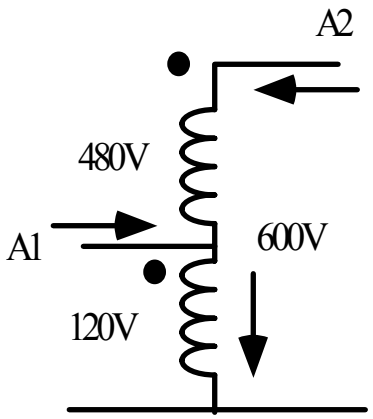
Other transformer connections:

Autotransformers:

- Special purpose transformer. Often used to create small increase or decrease in voltage with simpler internal construction

- One winding is used as the primary (or secondary). The other winding is connected in serie with this winding to create the secondary (primary) voltage. The series connection can add subtract depending on the polarities of the winding connections.





$$Vlow = V1$$

$$Vhigh = V1 + V2$$

$$\frac{V1}{N1} = \frac{V2}{N2} \qquad \text{so} \qquad Vhigh = V1 + \frac{N2}{N1}\cdot V1 = \frac{N1\cdot V1 + N2\cdot V1}{N1}$$

$$\text{or} \qquad Vhigh = Vlow\cdot\left(\frac{N1 + N2}{N1}\right)$$

$$\frac{Vlow}{Vhigh} = \frac{N1}{N1 + N2}$$

$$Ihigh = I2$$

$$Ilow = I1 + I2$$

$$N1\cdot I1 = N2\cdot I2 \qquad Ilow = \frac{N2}{N1}\cdot I2 + I2 = Ihigh\cdot\left(\frac{N2 + N1}{N1}\right)$$

$$\frac{Ilow}{Ihigh} = \frac{N2 + N1}{N1}$$

If this is an ideal transformer:

$$|Slow| = |Vlow|\cdot|Ilow| = |Shigh| = |Vhigh|\cdot|Ihigh|$$

$$|Slow| = |V1|\cdot|I1 + I2| = |V1|\cdot\left|I1 + \frac{N1}{N2}\cdot I1\right| = |V1|\cdot\left|\left(\frac{N2 + N1}{N2}\right)\cdot I1\right|$$

$$|S1| = |V1|\cdot|I1|$$

so:

Apparent Power Rating Advantage:

$$\frac{|Slow|}{|S1|} = \frac{N2 + N1}{N2}$$

The series impedance is reduced by 1 the apparent power rating advantage. In some applications this is good, but it also increases short circuit current.

- Autotransformers are used in many of the transmission level substations in this region.

Example: An autotransformer is used to connect a 12.6-kV distribution system line to a 13.8kV distribution line. It must be capable of handling 2000 kVA.

kVA := kW

(a) What must the N1:N2 turns ratio be to accomplish this connection?

(b) What is the required apparent power rating for the transformer windings