Acknowledgment- These handouts and lecture notes given in class are based on material from Prof. Peter Sauer’s ECE 330 lecture notes. Some slides are taken from Ali Bazi’s presentations.

Disclaimer- These handouts only provide highlights and should not be used to replace the course textbook.
DOT MARKINGS

• Dots relate the flux direction between coils.
• If two fluxes are in the same direction, they add, otherwise, they subtract.
• Depending which ends you connect the load to the secondary coil you either get an Output voltage in sync. With the input voltage or in reverse phase.
DOT MARKINGS

• The polarity markings are assigned such that a positively increasing current in the dotted terminal in one winding induces a positive voltage at the dotted terminal of the other winding.
DOT MARKINGS

- Assume the following configuration.
  1) Select one coil and one terminal and place a dot on that terminal.
  2) Assume a current is flowing and determine the flux direction.
  3) Place a test current in the second coil and determine its flux direction.
DOT MARKINGS

4) If $\phi_1$ and $\phi_2$ add, then place dot on 2 (where test current enters).

5) If they subtract, then place dot on 2’ (where test current leaves).
DOT MARKINGS

• Practical determination of dot locations:

1) Build the following circuit.

- Turn the switch on => pulse is generated where $\frac{di}{dt}$ is not zero on the secondary side.
- If the pulse causes the meter (V) to read positive, then the dot on the secondary is on the top terminal.
- If (V) reads a negative pulse, then the dot is on the lower side.
EXAMPLES

The dots in the circuit below are as shown.
WRITING EQUATIONS WITH MUTUALLY COUPLED COILS

Suppose we have two mutually coupled coils and the dot markings are as shown.

The self induced voltage due to the self inductance is in the direction of the current and is a voltage drop. The polarity of the mutually induced voltage depends on the dot marking.
WRITING EQUATIONS WITH MUTUALLY COUPLED COILS

If the current enters the dotted terminal of one coil, the voltage will be positive at the dot on the second coil.

\[ v_1 = i_1 R_1 + L_1 \frac{di_1}{dt} + M \frac{di_2}{dt} \]

\[ v_2 = i_2 R_2 + L_2 \frac{di_2}{dt} + M \frac{di_1}{dt} \]

Source: jacks-university.de
WRITING EQUATIONS WITH MUTUALLY COUPLED COILS

If the current enters the dotted terminal of one coil, the voltage will be positive at the dot on the second coil.

\[ v_1 = i_1 R_1 + L_1 \frac{di_1}{dt} - M \frac{di_2}{dt} \]

\[ v_2 = i_2 R_2 + L_2 \frac{di_2}{dt} - M \frac{di_1}{dt} \]
WRITING EQUATIONS WITH MUTUALLY COUPLED COILS

A current entering the undotted terminal of one coil provides a voltage that is positively sensed at the undotted terminal of the second coil.

\[ v_2 = M \frac{di_1}{dt} \quad \text{if} \quad i_1 \text{ enters undotted terminal of } L_1 \]

\[ v_2 = -M \frac{di_1}{dt} \quad \text{if} \quad i_1 \text{ enters undotted terminal of } L_2 \]
WRITING EQUATIONS WITH MUTUALLY COUPLED COILS

- If the reference current in a coil leaves the dotted (undotted) terminal, then the voltage induced at the dotted (undotted) terminal of the other coil has a negative sign.
• Reading material: Section 3.3.

• Recommended reading for next time: Sections 3.4.1 and 3.4.2.