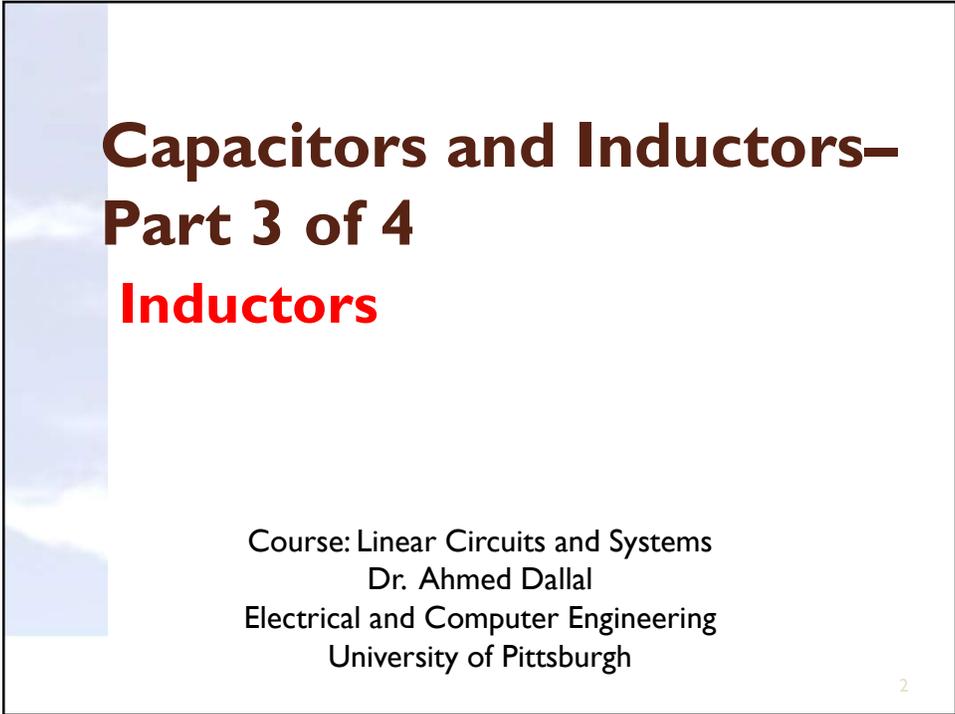


- Linear Circuits and Systems



## Capacitors and Inductors— Part 3 of 4

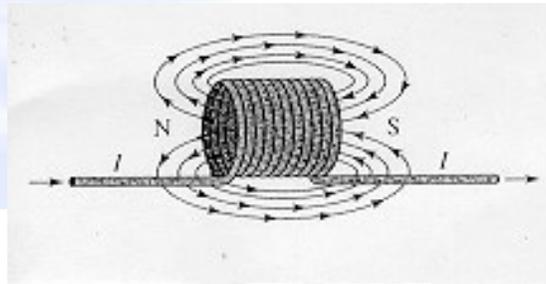
### Inductors

Course: Linear Circuits and Systems  
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## Inductance

- Electric current passing through a conductor will produce magnetic field or flux around it.
- If the wire conductor is wound around a core, magnetic field /flux will resemble like permanent magnetic bar.



## Inductance

- Inductance quantifies inductor's ability to store energy in a magnetic field when electrical current flows through it and is measured in Henry (H)
- The inductance of the coil,  $L$ , depends on permeability of core,  $\mu$ , and physical construction (length  $l$ , area of cross-section  $A$ , and number of turn  $N$ )

$$L = \frac{\mu AN}{l}$$

## Inductance

- Magnitude of flux produced depends on magnitude of current , I, and the inductance of the coil/inductor.

$$\phi = L I$$

## Flux varies with time

- If the current in the inductor is varied with time (t), flux  $\phi$  will also varied with time. Variation of flux in the windings will induce voltage.

$$d\phi = L dI$$

## Energy stored in inductor:

Voltage  $v = L \frac{di}{dt}$

Power  $p = iv = iL \frac{di}{dt}$

For duration of  $dt$  sec

$$dw = p dt = Li \frac{di}{dt} dt = Lidi$$

For current changes between  $i = 0$  to  $i = I$

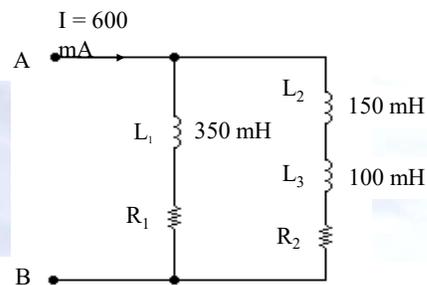
$$W = L \int_0^I idi = L \left[ \frac{i^2}{2} \right]_0^I = \frac{1}{2} LI^2$$

Inductor stores energy in the form of magnetic fields.



## Example

By supplying a total of constant current at 600 mA,  $L_1$  is found to store an energy of 28 mJ in its magnetic field. Calculate the total energy stored in  $L_2$ ?



$$W_1 = \frac{1}{2} L_1 I_1^2$$

$$I_1 = \sqrt{(2W_1/L_1)} = \sqrt{[(2 \times 28 \times 10^{-3}) / (350 \times 10^{-3})]} = 400 \text{ mA}$$

$$I_2 = I - I_1 \text{ (Kirchoff's current law)} = 600 - 400 = 200 \text{ mA}$$

$$W_2 = \frac{1}{2} L_2 I_2^2 = \frac{1}{2} \times 150 \times 10^{-3} \times (200 \times 10^{-3})^2 = 3 \text{ mJ}$$

## Conclusion



## Acknowledgement

This material is based upon work partially supported by the National Science Foundation under Grant# 2335802. Any opinions, findings, and conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



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**THE END**