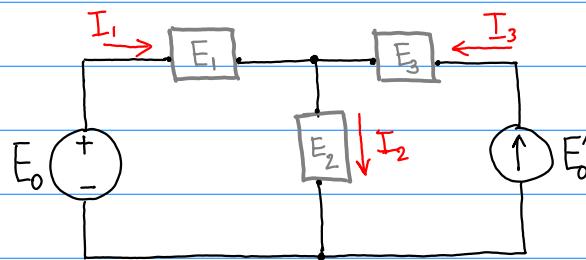


Lecture # 01Electric Circuits: Circuit Elements

Electric Circuits: An electric circuit (or network) is an interconnection of electrical circuit elements linked together in a closed path so that an electric current may continuously flow.



Electric circuit →  
Sources & Sinks.

here,  $E_0$  = Voltage Source

$E'$  = Current Source

$E_1, E_2, E_3$  = Elements (Resistor, Capacitor, Inductor...  
...)

Circuit Elements   
Sources  
Sinks

We define two kinds of ckt. elements

1) Active Elements

2) Passive Elements

1) Active Elements : Capable to supply non-zero average power to the ckt (ext'l/int'l.) over an infinite time interval.

Examples :

1) Sources : Voltage source, Current Source

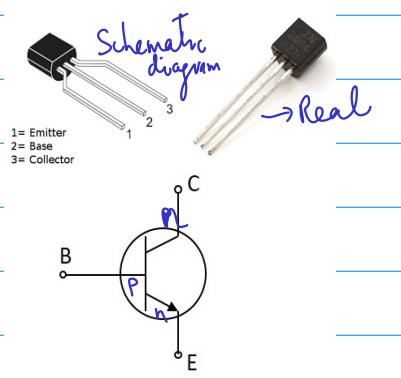


Battery

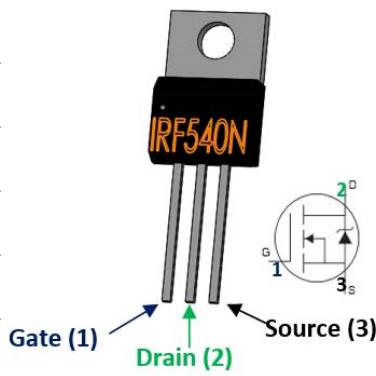
DC power Supply (Lab.)

2) Semiconductor Devices : Transistors (BJTs, MOSFETs)  
Op-Amp. etc.

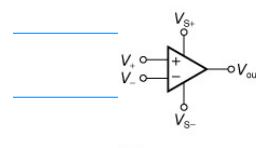
- Power gain in the ckt.



BJTs



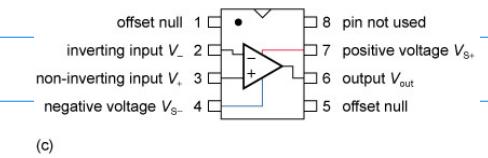
MOSFETs



(a)



(b) 1 2 3 4 5 6 7 8



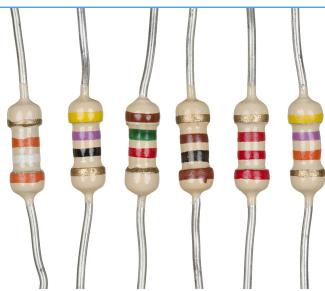
(c)

Op-Amp.

2) Passive Elements : Not capable to supply non-zero average power to the ckt. over an infinite time interval.

- No power gain.

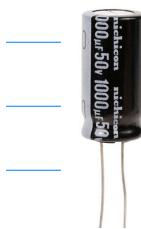
Examples :



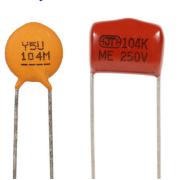
Resistors

$$I^2 R$$

Polar/electrolyte



Non-polars



Polar



Inductors

$$\frac{1}{2} L I^2$$



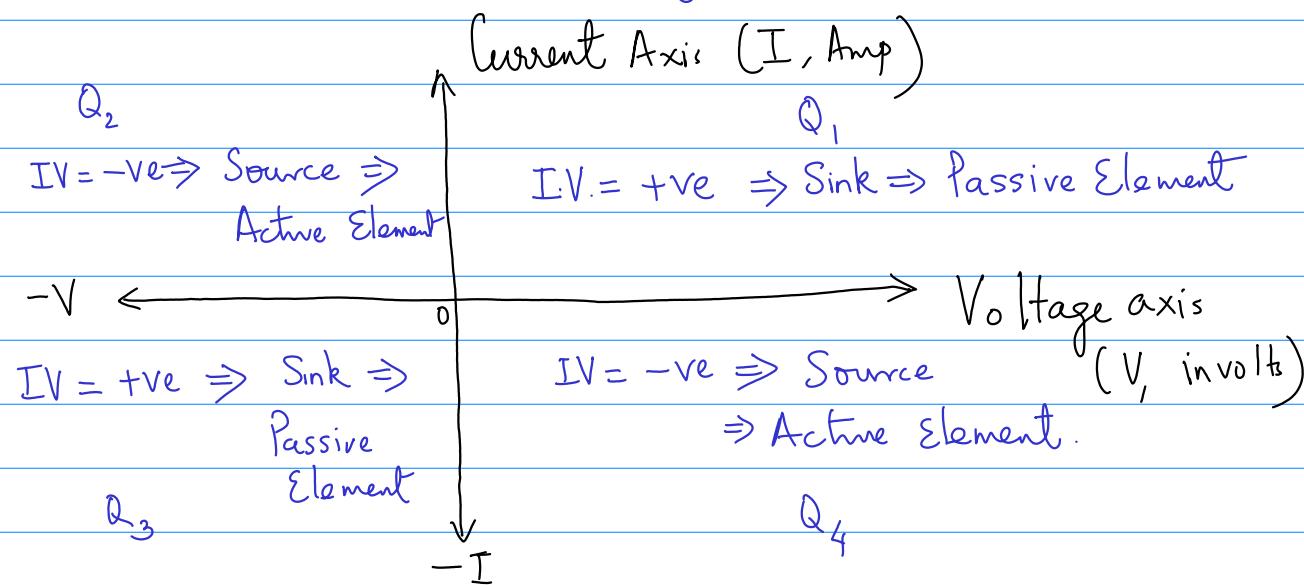
Transformers

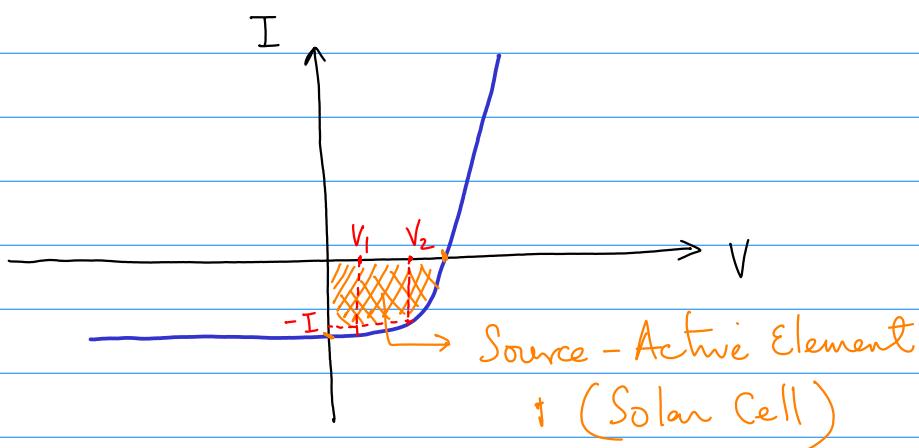
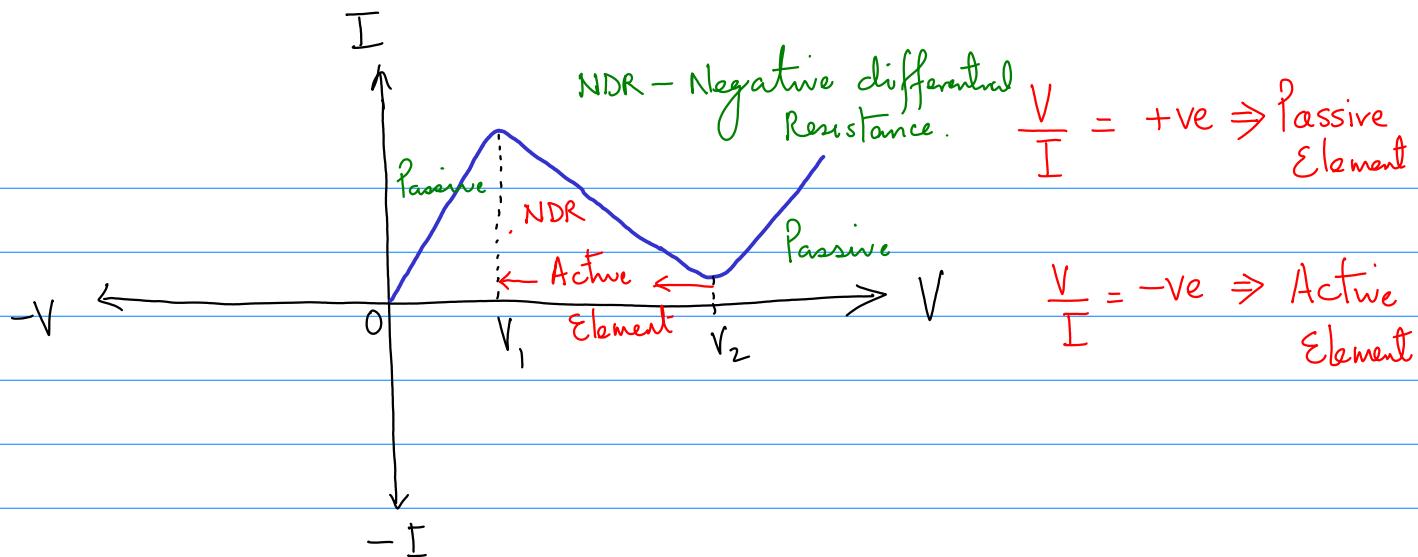
$$P_{in} = P_{out} \text{ (ideal)}$$

$$I_p V_p = I_s V_s$$

- ideal transformer

Identification of the type of ckt. elements





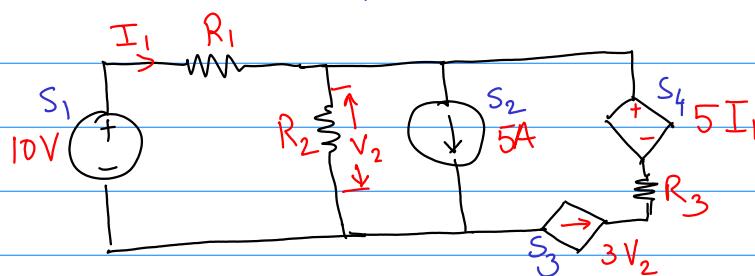
Sources :

Independent Sources

Dependent Sources

Independent Sources : The element for which both voltage and current don't depend on the voltage or current elsewhere in the ckt.

Dependent Sources : The element for which both voltage & current depend on the voltage & current elsewhere in the ckt.

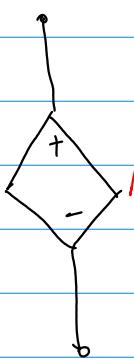


$S_1$  = Independent Source

$S_2$  = "

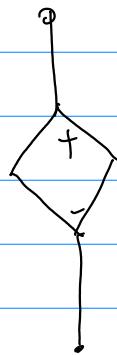
$S_3$  } Dependent Sources  
 $S_4$  }

## Dependent Sources :



$AV_x$

VCVS



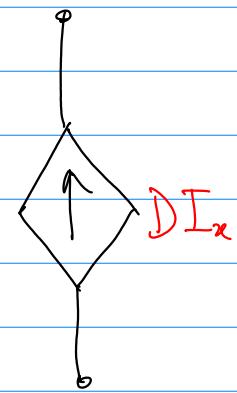
$BI_x$

CCVS



$CV_x$

VCCS



$DI_x$

CCCS

Voltage Controlled voltage  
Source