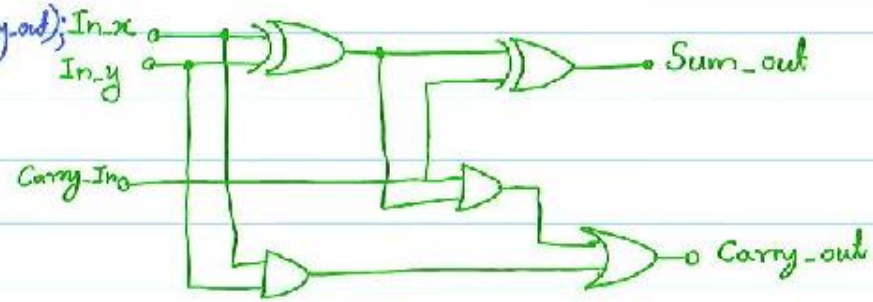
4) Module Level Design Stage :

- Design and simulate functional module using HDL.
- Auto-generation of layout for the complete module using synthesis.

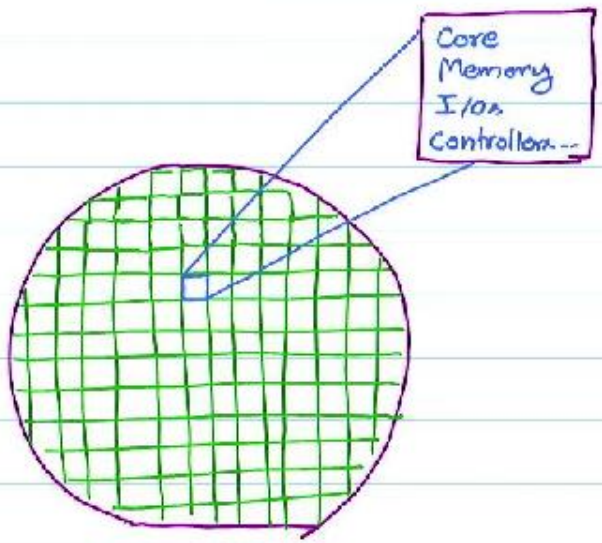
```
module full_adder (in_x, in_y, carry_in, sum_out, carry_out);
  input  in_x ;
  input  in_y ;
  input  carry_in ;
  output sum_out ;
  output carry_out ;
  wire   w_sum1 ;
  wire   w_carry1 ;
  wire   w_carry2 ;
  assign carry_out = w_carry1 | w_carry2 ;
      // instantiate two half-adder to make the circuit
```

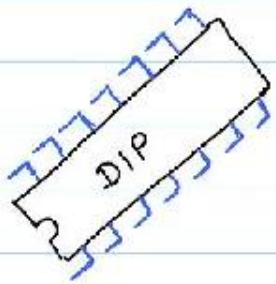



```
half_adder u1_half_adder
(
   .in_x (in_x),
   .in_y (in_y),
   .out_sum (w_sum1),
   .out_carry (w_carry1),
);
half_adder u2_half_adder
(  .in_x (w_sum1),
   .in_y (carry_in),
   .out_sum (sum_out),
   .out_carry (w_carry2),
);
endmodule
```

5) IC Design Stage :

- Complete function design (various Analog and Digital Modules)
- Timing and power constraints taken from circuit design stage.
- Synthesize complete function using HDL,
- Place and route for minimum space / power density.





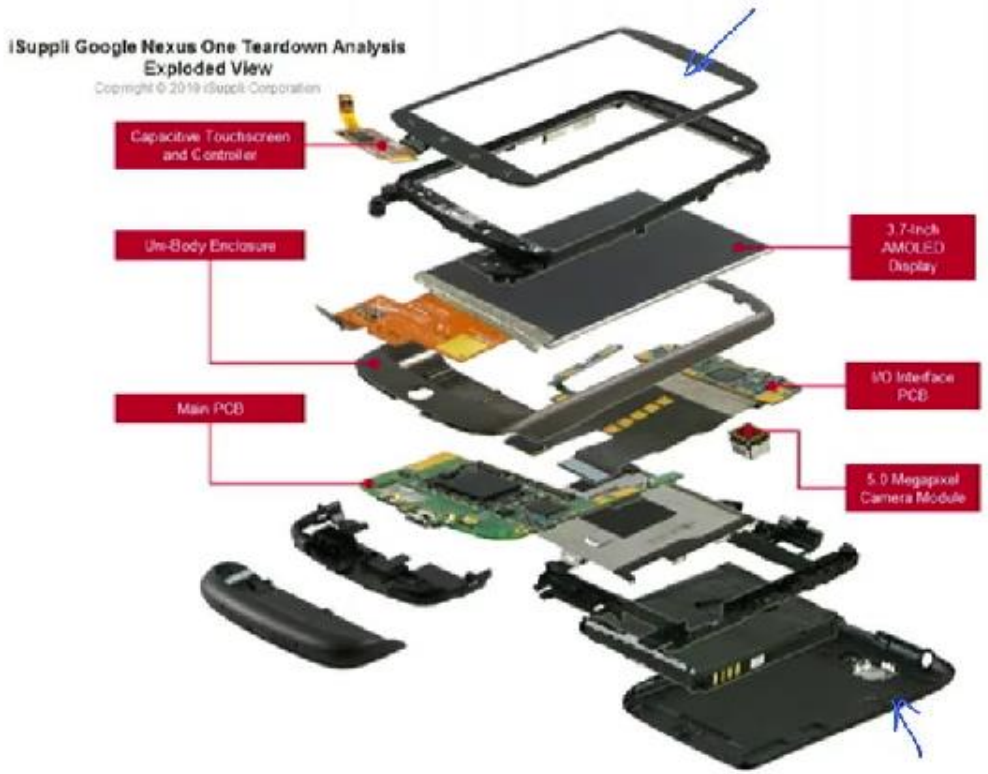
Package.

6) System Design stage :

- Processor
- RFIC
- RF Switches
- Memory
- Screen driver.

- Printed circuit Board (PCB)

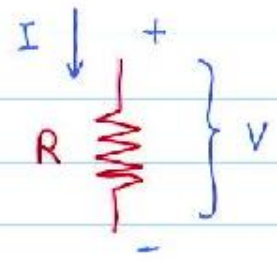
- Multiple ICs are used to make complete product.
- For example:
  - Processor.
  - RFIC.
  - RF Switches.

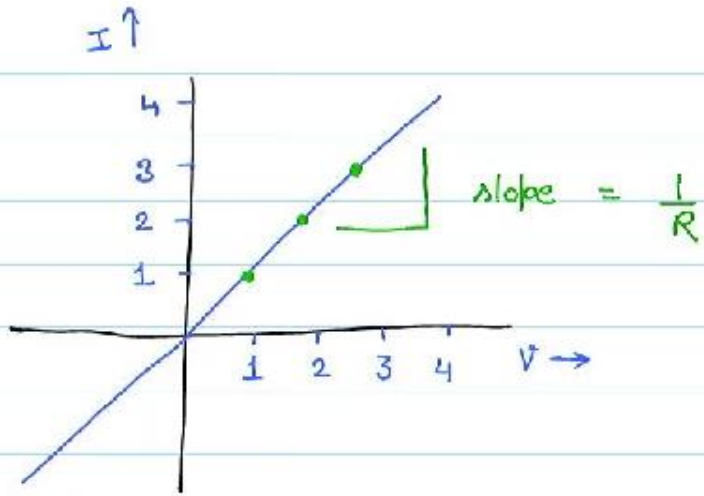


Basic Circuit Elements ;

- Resistor (ohm's law)
- Capacitor (based on energy storage in electric field)
- Inductor (based on energy storage in magnetic field)
- Voltage Sources (like battery)
- Current Sources (constant current)

1) Resistor (R)



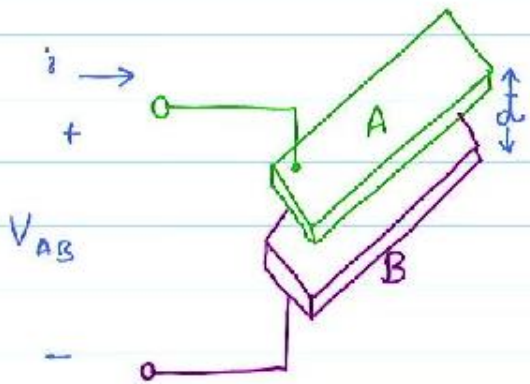


- All wires and circuit connections have resistance
  - → Though we most often approximate them to "0".

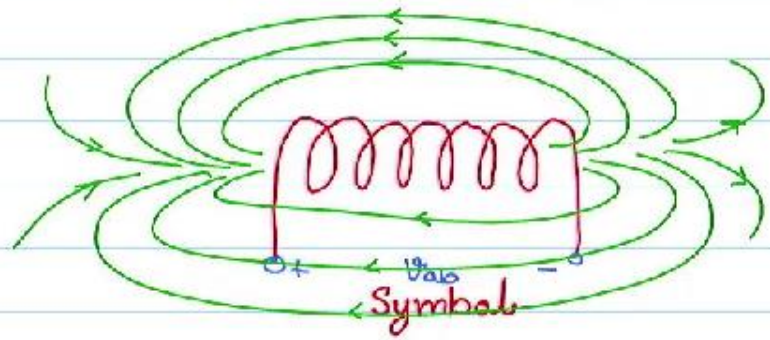
2) Capacitor (C):

Any two conductors a and b, separated by an insulator.

symbol



3) Inductor : Inductors are the dual of capacitors - they store the energy in magnetic fields.



Capacitor	Inductor
$i = C\frac{dV}{dt}$	$v = L\frac{di}{dt}$
$E = \frac{1}{2}CV^2$	$E = \frac{1}{2}LI^2$