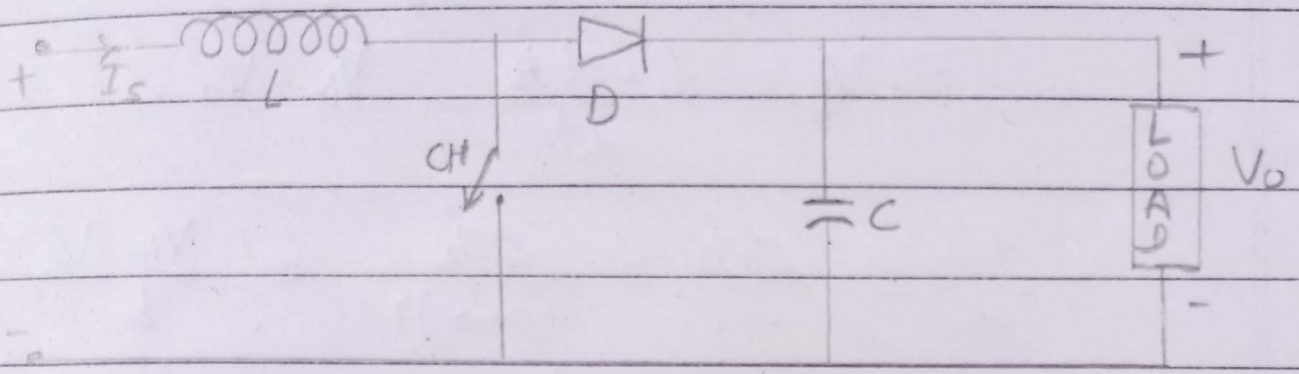
Step-Up Chopper
or Boost Converter

It is used to increase voltage level of its output side.



The inductor connected to i/p source leads to a constant i/p current, & thus the boost converter is seen as the constant current i/p source. And the load can be seen as a constant voltage source. The switch is turned ON & OFF by using PWM.

Mode 1 - CH is ON, D is OFF

If CH is ON for T_{ON} time, switch is short circuited.

Using KVL,

$$V_{in} = V_L = L \cdot \frac{di_L}{dt}$$

$$\frac{di_L}{dt} = \frac{\Delta i_L}{\Delta t} = \frac{\Delta i_L}{\alpha \cdot T} = \frac{V_{in}}{L}$$

$$\boxed{(\Delta i_L)_{closed} = \left(\frac{V_{in}}{L}\right) \cdot \alpha T}$$

Mode 2 - CH is OFF, diode is ON

In this mode, polarity of inductor is reversed & energy stored in inductor is dissipated in load resistance.

Using KVL

$$V_{in} = V_L + V_o$$

$$\Rightarrow V_L = L \cdot \frac{di_L}{dt} = V_{in} - V_o$$

$$\frac{di_L}{dt} = \frac{\Delta i_L}{\Delta t} = \frac{\Delta i_L}{(1-\alpha)T} = \frac{V_{in} - V_o}{L}$$

$$\left(\because T_{OFF} = T - T_{ON} = T - \alpha \cdot T = T(1-\alpha)\right)$$

$$(\Delta i_L) = \left(\frac{V_{in} - V_o}{L}\right) \cdot (1-\alpha)T$$

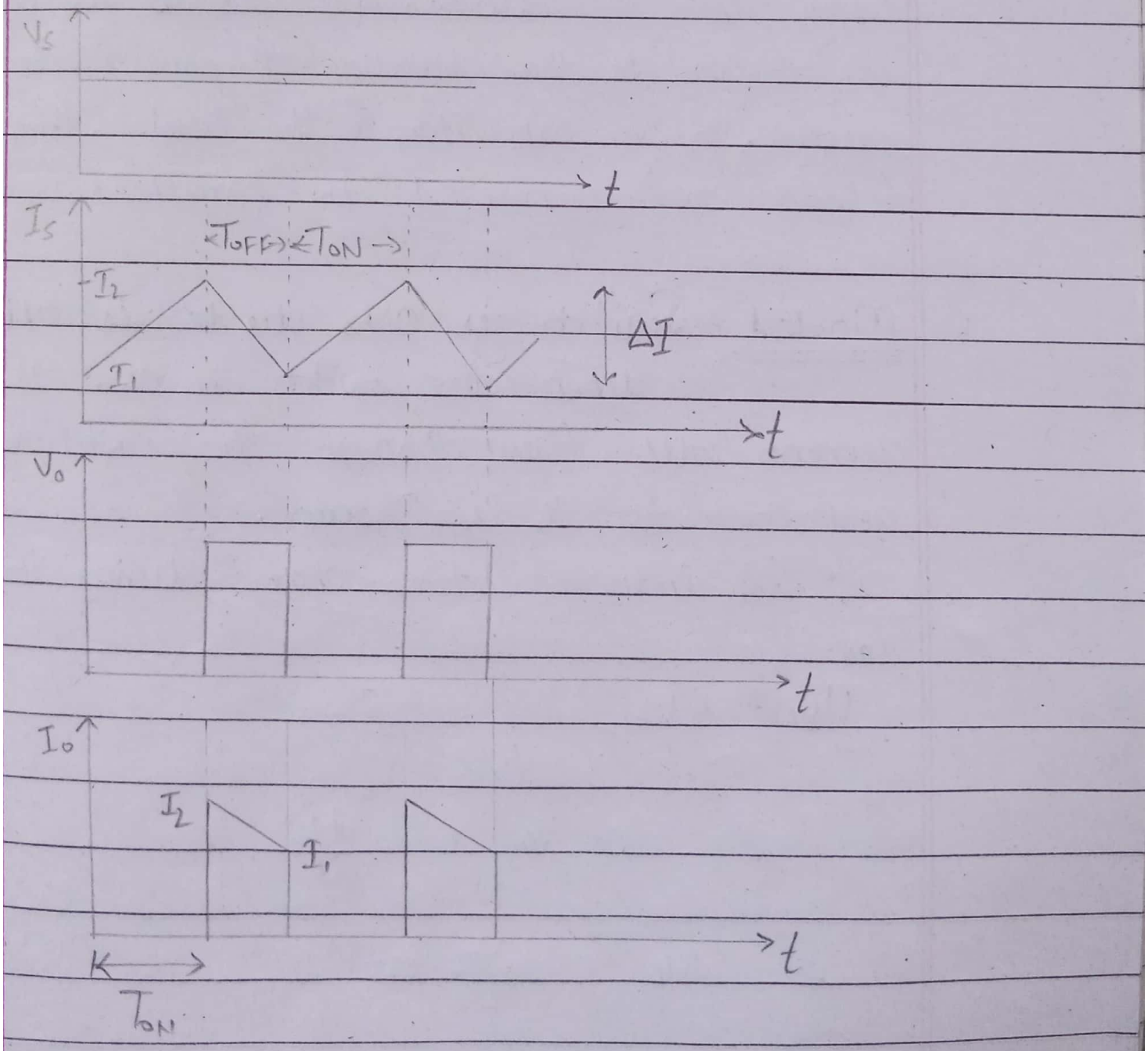
As we know,

$$(\Delta i_L)_{closed} + (\Delta i_L)_{open} = 0$$

$$\Rightarrow \left(\frac{V_{in} - V_o}{L}\right) \cdot (1-\alpha) \cdot T + \left(\frac{V_o}{L}\right) \cdot \alpha T = 0$$

$$\Rightarrow \boxed{\frac{V_o}{V_{in}} = \frac{1}{1-\alpha}}$$

(where $0 \leq \alpha \leq 1$)



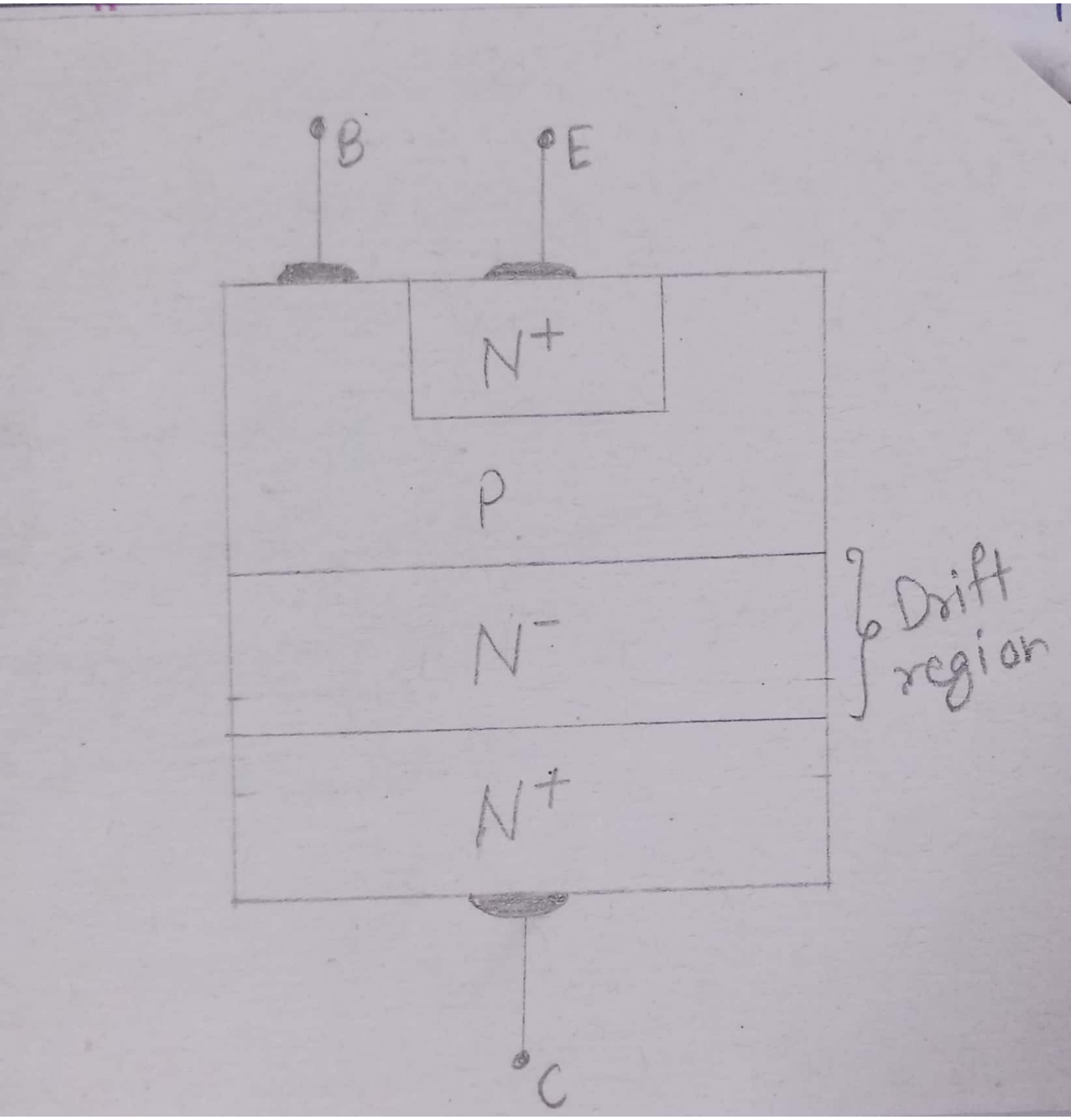
Power BJT
(Power Bipolar Junction Transistor)

A transistor is a device that regulates current or voltage flow & acts as a switch or gate for electronic signals. It consists of three layers of a semiconductor material, each capable of carrying a current.

The BJT blocks a high voltage in OFF-state & high current carrying capacity in the ON-state. The power handling capacity is very high.

Construction of Power BJT-

It has three terminals Collector, Emitter (E) & Base (B). It is vertically



oriented four-layers structure. The vertical structure uses to increase the cross-sectional area.

It has four layers. The first layer is heavily doped emitter layer (n+). The second layer is moderately doped base layer (P). The third region is lightly doped collector drift region (n-). The last layer is highly doped collector region (n+).

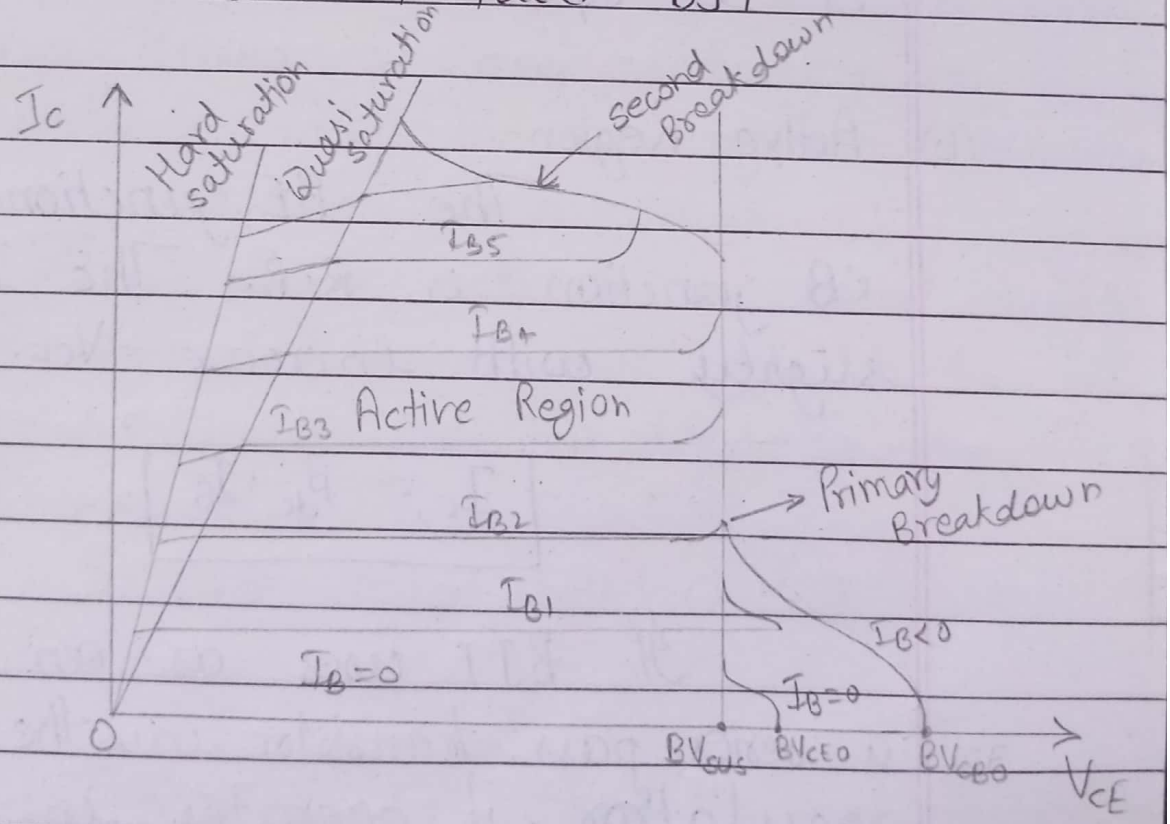
Working of power BJT

As the Base & emitter junction is in forward bias (F.B.) and C-B junction is in reverse bias (R.B.). Because of F.B. at the B-E, the flow of the majority carriers takes place from the emitter to base.

As the region at the base, is of light doping, not all the majority carriers combine, some of them tends to flow towards the collector. In this way, the currents at the E, B & C generated.

- $I_E = I_B + I_c$
- $I_B < I_E$ & $I_B < I_c$

VI - Characteristics of Power BJT -



$I_{B1} < I_{B2} < I_{B3} < I_{B4} < I_{B5}$

There are two junctions BE & CB junctions.

Application of boost converter

(i) In regulated DC power supply.
(ii) In regenerative braking of DC motors
(iii) As switching regulators
(iv) In portable device applications
(v) In battery powered applications.

Application of BJT -

(i) Switching
(ii) Amplification.