Roll Number: 715

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Mid Semester Examination

Group A

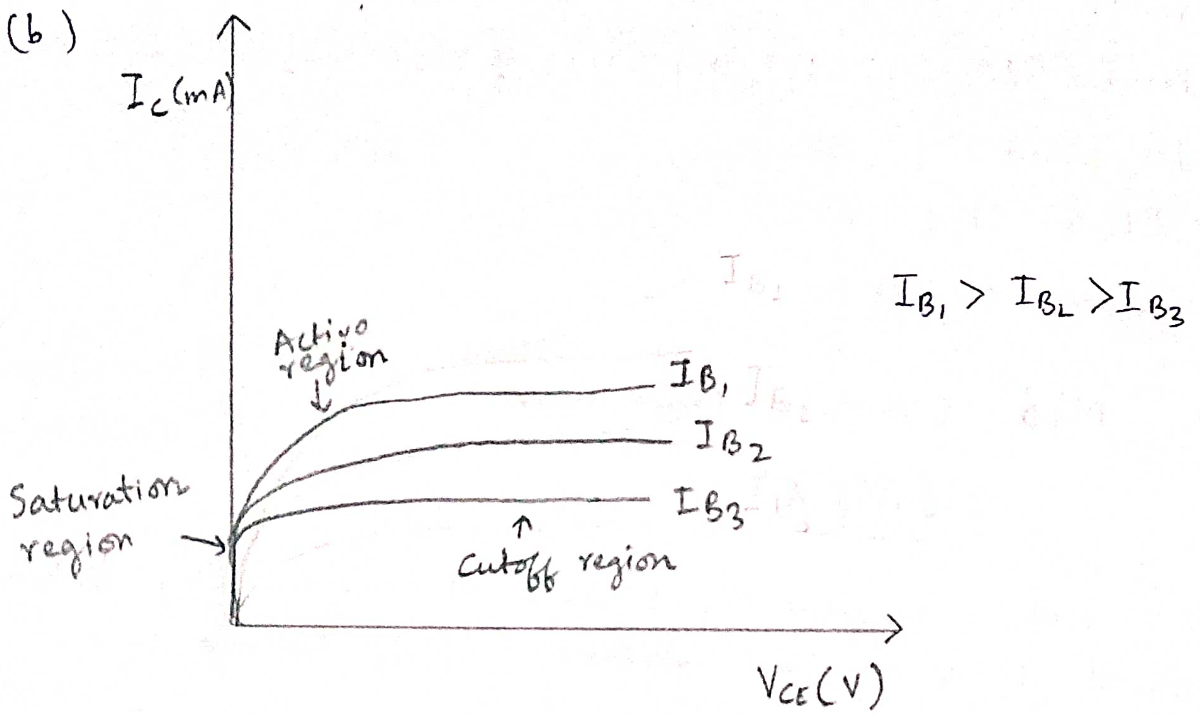
1. (a) A current source is an active circuit element that is capable of supplying constant current flow to a circuit regardless of the voltage developed across its terminals.

A voltage source is a circuit element which can maintain a fixed voltage across the circuit regardless of the current flowing in the circuit.

(b) The Maximum Power Transform Theorem states that a DC voltage will transfer maximum power to the variable load resistance if the load resistance is equal to the source resistance.

3. (a) The word ~~tranist~~ 'transistor' is a combination of the words 'transfer' and 'resistance'. ~~This~~ ~~It~~ Since it transfers resistance from one end of the device to the other end, it is called a 'transistor'.

(b)



4. α and β refer to Bipolar Junction Transistors. α is the ratio of collector current to emitter current, while β is the ratio of collector current to base current in a bipolar junction transistor.

From ~~Kircho~~ Kirchhoff's current law, we obtain,

$I_E = I_C + I_B$, where,

I_E = emitter current,

I_C = collector current

I_B = base current

~~Dividing~~

$$\Rightarrow \frac{I_E}{I_C} = \frac{I_C}{I_C} + \frac{I_B}{I_C}$$

$$\Rightarrow \frac{I_E}{I_C} = 1 + \frac{I_B}{I_C}$$

But, $\alpha = \frac{I_C}{I_E}$ and $\beta = \frac{I_C}{I_B}$

$$\Rightarrow \frac{1}{\alpha} = 1 + \frac{1}{\beta}$$

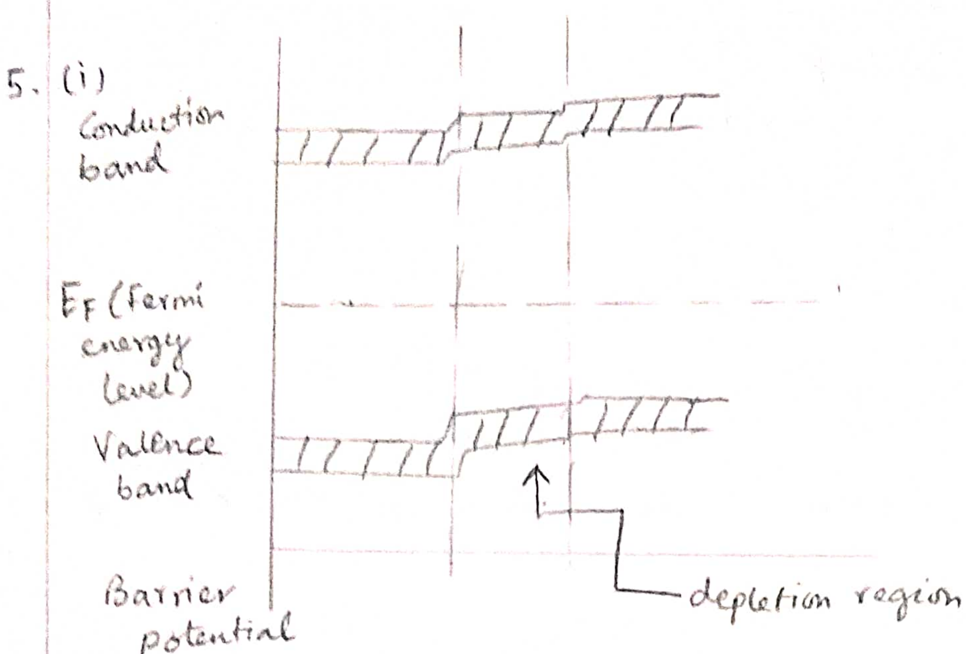
$$\Rightarrow \frac{1}{\alpha} = \frac{1+\beta}{\beta}$$

$\Rightarrow \alpha = \frac{\beta}{1+\beta}$, which is the relation between α and β

or $\beta = \frac{\alpha}{1-\alpha}$

Group B

5. (i)



(ii) An n-type semiconductor is created by introducing pentavalent impurity elements like antimony, arsenic and phosphorous. However, it is still electrically neutral since ideally the number of positively charged protons in the nuclei is still equal to the number of free and orbiting negatively charged electrons in the ~~str~~ structure.

(iii) The diode current equation of a p-n junction diode is:

$$I = I_0 \left(e^{\frac{qV}{nKT}} - 1\right), \text{ or}$$

$$I = I_0 \left(e^{\frac{V}{nKT/q}} - 1\right), \text{ where}$$

I = current of semiconductor diode

I_0 = reverse saturation current

q = electronic charge (1.6×10^{-19} C)

V = forward voltage

k = Boltzmann's constant

n = emperical constant

T = temperature in Kelvin

But, $V_T = \frac{kT}{q}$ where

$V_T =$ thermal voltage

Hence,

$$I = I_0 \left(e^{\frac{V}{nV_T}} - 1\right)$$

6. (i)

Zener breakdown	Avalanche breakdown.
• It is observed in lightly doped pn junction diodes.	• It is observed in ~~low~~ heavily doped pn junction diodes
• Depletion region width is more and it requires higher potential for charge carriers to pass.	• Depletion region width is ~~to~~ lesser and it requires ~~low~~ ~~lower~~ relatively lower potential for charge carriers to pass.

(ii) Static resistance : It is also known as DC resistance. When DC is applied to a circuit, the current flows in a single direction. In such cases, the resistance offered by the diode is called static resistance.

Dynamic resistance : It is also called AC resistance. When AC is applied the current flows in either direction. The ~~resistance~~ resistance offered by the diode in such cases is called dynamic resistance.

(iii) Ge has been replaced by Si because Si has a larger band gap than Ge and Si is more abundant in nature than Ge.