ASSIGNMENT BPT 401

— Krista sir

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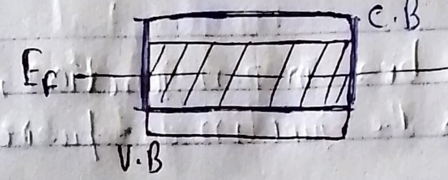
1) What is the difference between the band gap formation in metal, semi-metal & semi-conductor.

In metals:-

→ Conduction band & Valence band overlap each other leaving zero band gap between them.

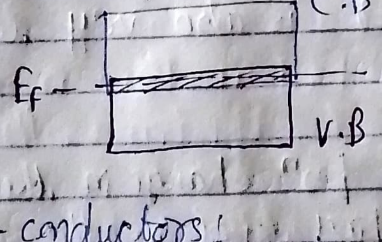
→ In metal, fermi level have large space/amount for conduction & valence band overlapping.



In Semi-metals:-

→ There is a very little overlapping between conduction band & valence band & hence zero band gap.

→ fermi level has very less amount of overlapping of bands.



In Semi-conductors:-

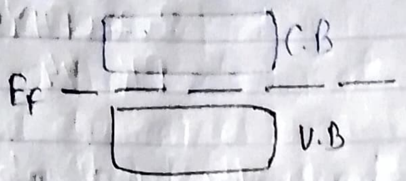
→ There is a very little band gap exist in semiconductors (no overlapping).

↳ It is the minimum energy required to make conduction.

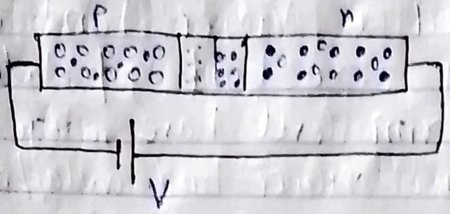
↳ Fermi level lies in somewhere in the middle of semiconductor depending upon its types.

1)

For e.g. → for intrinsic semiconductor → E_F lies exactly in middle of bands



2) Why do we have conduction in the reverse bias cond^n of a p-n junction?



In case of reverse bias in p-n junction, majority carriers cannot cross the junction as repulsive force increases.

As reverse bias voltage increased, energy bands on p-side are raised up.

While for minority charge carrier this p-n junction in reverse bias behaves as forward bias & since minority charge carrier are very less no. so, the current minority carriers is also very less or is negligible.

3) Why the Fermi level pos^n change in the band gap as we alter the doping level in the semiconductor materials?

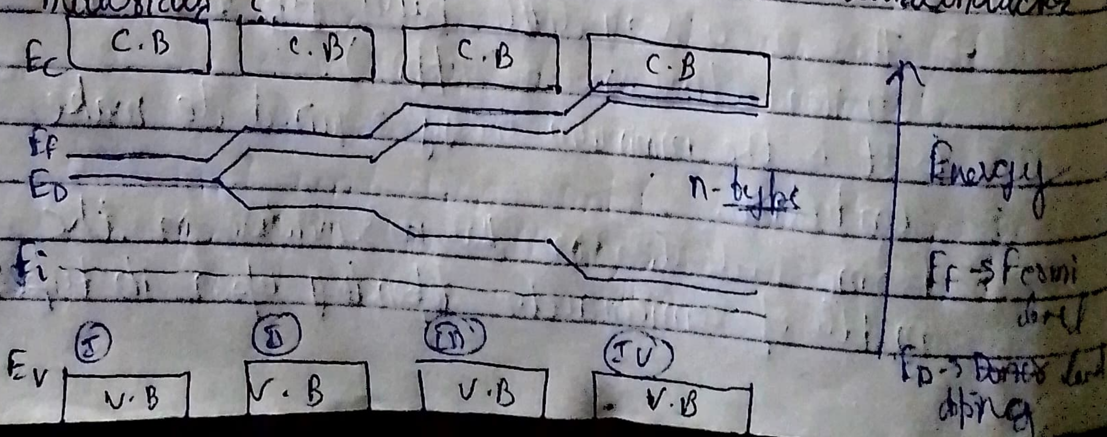


fig I → low doping fig III → high doping
fig II → Med^m " fig IV → extremly high doping

3) ~~fig~~

For n-type semiconductor:

As doping conc^n increases, i.e. more number of penta-valent atoms doped, so more number of electrons are available in donor will be available. As a result, centre of ~~mass of electrons~~ gravity position of electrons shifted upwards.
So, fermi level shift towards conduction band.

~~So~~ → In fig. IV E_F is inside C.B. represents extremly high doping.

For p-type semiconductor
Similarly, as in n-type semiconductor, here holes concentration increases due to trivalent impurity.

So, fermi level shift towards valence bands.

4) What is the difference between Zener Diode & Avalanche breakdown in a p-n junction?

Zener Diode	Avalanche Breakdown
→ Only happens when doping conc^n is extremly high. So, the depletion region become very narrow.	→ Due to Avalanche effect → If reverse bias voltage is very high, then the depletion region widens, & the electric field is quite strong.
→ Electric field is very strong & extremly narrow. So, charge carrier can't get accelerated. Instead a quantum mechanical effect takes place.	→ Minority carrier get accelerated in this depletion region & gain K.E.

4)

- This is k/a quantum tunneling. So, there is no impact ionization, the electron just tunnel through (like a digging a hole, instead of overcoming the mountain).

- So most $e^{\ominus}$ tunnel through, & some of course will give impact ionization.

- Once the field is strong enough, they can knock off other $e^{\ominus}$ from the ~~tve~~ in the depletion region.

- This $e^{\ominus}$ can in turn can knock off other $e^{\ominus}$ from -ve ions on depletion region. So, large no. of $e^{\ominus}$ are available for conduction.

- However, due to impact ionization, heat is generated & this heat could destroy the diode.

5) Why there is no conduction of charges in the lower value of the applied forward bias condition in the p-n junction?

In forward biasing of p-n junction diode, initially due to the high depletion width no electron can cross the barrier & hence no conduction.
As forward bias voltages increases, electron & holes are pushed by battery from n-side & p-side respectively. As a result, depletion width decreases.

Although the depletion width is decreasing, ~~still~~ no. of electrons crossing the barrier is still very less. i.e. we get negligible or ~~ze~~ zero current.

We don't conduction until forward bias voltage is equal to barrier voltage, then the energy bands

on two sides are aligned & majority carriers can cross the junction.
And when, majority carriers can easily cross the junction, we get conduction until ~~the~~ we get ~~negligible~~ no conduction.

THE END