"Dissemination of Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur

(Empowered Autonomous)

Department of Physics

Notice

Date : 02-12-2023

All the students of M.Sc. II are informed that **Open Book Test** on Topic **"Solid State Physics - II"** will be conducted on 4th December 2023 from 2.00 PM to 3.00 PM at Department of Physics. Attendance is mandatory.

Teacher Incharge ...ShindeAV.....
(Mr. A. V. Shinde)

sslatthe
Dr. S. S. Latthe
HEAD
DEPARTMENT OF PHYSICS
VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)

"Dissemination of Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

M.Sc. Part- II

Solid State Physics II

Open Book Test

Date: 04/12/2023 **Total Marks: 20**

Day: - Monday **Time: - 2pm to 3pm**

Instructions: -

1) All questions are compulsory.
2) Each question carries 4 marks

Q.1) Write a short note on types of semiconductors

Q.2) State difference between direct and indirect band gap semiconductor

Q.3) Write a short note on variation of energy bands with alloy composition.

Q.4) Explain Zener diode. Also explain Zener and Avalanche breakdown.

Q.5) Explain Principal, Construction and working of solar cell.

"Dissemination of Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

M.Sc. II

Open Book Test

Solid State Physics II

Attendance Sheet

Date : 04/12/2023

Roll. No.	Name of Candidate	Sign
1602	Shruti H. Bam	Shruti
1601	Snehal N. Ahivale	Snehal
1603	Anand N. Biradar	Anand
1606	Shivaraj C. Kavatagi	SHK
1609	Shivani D. Jagdar	Shivani
1611	Dnyaneshwari P. Todkar	Dnyaneshwari
168	Rajshree Randive	Rajshree

Teacher Incharge.....ShindeAV.....

(Mr. A. V. Shinde)

VIVEKANAND COLLEGE KOLHAPUR (An Autonomous) ESTD JUNE 1964

"Dissemination of Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

M.Sc. II

Solid State Physics II

Open Book Test

Result

Date : 04-12-2023

Roll. No.	Marks
1601	17
1602	17
1603	16
1604	-
1605	-
1606	18
1607	18
1608	17
1609	19
1610	-
1610	-
1611	18
1612	-

Teacher Incharge.....Shinde AV.....

(Mr. A. V. Shinde)

HEAD
DEPARTMENT OF PHYSICS
VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Date:- 4-12-2023 Shivani Dattatray Nagar

।। ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ।।

– शिक्षणमहर्षी डॉ. बापूजी साळुंखे 34547

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor :

Suppliment No. :

Roll No. : 1609

Class : MSc. II

Subject : Solid state Physics -II

Test / Tutorial No. : Open Book Test

Div. :

19/20

Q.1 Write a short note on types of Semiconductor

→ There are two types of semiconductor

(a) Intrinsic semiconductor (b) Extrinsic semiconduct

(a) Intrinsic semiconductor

A pure perfect semiconductor with an ideal crystal structure is called as intrinsic semiconductor. The energy creats conduction electron - hole pairs for every free electron in the conduction band. there is hol in the valence band. limited conductivity of an intrinsic semiconductor at room temp. and under t influence of an external applied electric field is d to the motion of these equal no. of electrons and

(b) Extrinsic Semiconductor

When a small and controlled amount o a trivalent or pentavalent element is introduced into an intrinsic semiconductor. the resulting material called an extrinsic or doped semiconductor

(c) Doping

The process of introducing a small and controlled amount of a trivalent or pentavalent element to an intrinsic semiconductor is called doping.

The types of Extrinsic Semiconductor

There are two types extrinsic semiconductor

(a) n-type semiconductor (b) p-type semiconductor

Q.2 Differentiate between Direct band & Indirect band Gap.

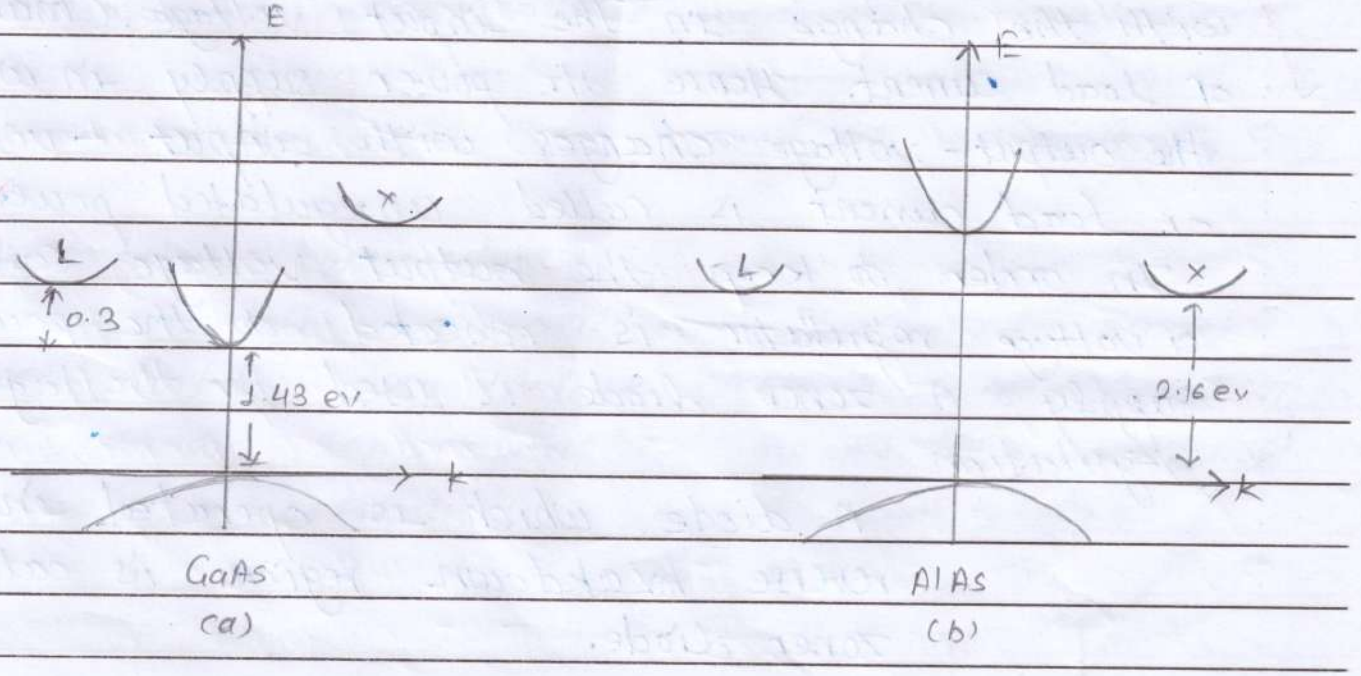
Direct Band Gap	Indirect Band Gap
1) Direct band gap is where the k-vectors is similar to the highest states in the valence band as far as the lowest states in the C.B	1) Indirect band gap is where the band gap where the max of the the valence ban minimum occur at differe values of k.
2) Efficiency is more efficient	2) efficiency is less efficien
3) It can directly emit a photon	3) It cannot emit a photon
4) electron rising from the valence band to the C.B will change the only potential.	4) electron rising from the valence band to the C.B will change the potential as well as momentum.
5) Amorphous silicon & III-IV materials InAs & GaAs	5) crystalline Si & Ge as well III-V materials AlSb are ex

2.3 Write a short note on variation of Energy bands with Alloy Composition

→

Variation of Energy Bands with alloy composition

- fig. given below illustrates the band structure of GaAs and AlAs, and the way in which the bands change with composition x in the ternary compounds $Al_x Ga_{1-x} As$.
- The binary compound GaAs is a direct material with a band Gap of 1.43 ev at room temp.
- for reference we call the direct (k-0) conduction band minimum Γ
- We call the lowest-lying GaAs indirect minimum L and other X
- In AlAs the direct Γ minimum is much higher than the indirect X minimum and this material is therefore indirect with a band gap of 2.16 ev at room temp.



- In the binary alloy $Al_xGa_{1-x}As$ all of these C.B minima move up relative to the V.B as the composition x varies from 0 (GaAs) to (AlAs).
- However the indirect minimum Al moves up less than the others & for composition above about 38 percent At this indirect minimum becomes the lowest-lying C.B
- Therefore ternary alloy AlGaAs is direct semiconductor for Al composition on the column III sublattice up to about 38 percent and is an indirect semiconductor for higher Al mole fractions.

Q.4. Explain Zener diode with zener and avalanche breakdown.

→ Zener diode as a voltage regulator -

Many electronic circuits need dc power supply. A full wave rectifier serve as a good dc power source. However, the main disadvantage of such power supply is that the output voltage changes with the change in the input voltage (main voltage) or load current. Hence the power supply in which the output-voltage changes with input-voltage or load current is called unregulated power supply. In order to keep the output voltage constant a voltage regulator is connected to the power supply. A zener diode is used for voltage regulation.

A diode which is operated in reverse breakdown region is called zener diode.

।। ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ।।
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे
34573
Shri Swami Vivekanand Shikshan Sanstha Kolhapur's
VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 1.
Roll No. :
Class :

Subject :
Test / Tutorial No. :
Div. :

The Zener breakdown :

The mechanism of zener breakdown is two types.

(i) zener breakdown & (ii) Avalanche breakdown

Zener Breakdown :

The application of reverse bias voltage across the depletion region creats an electric field of order of 3×10^5 v/cm. This electric field exerts a force on the valence electron and breaks down the covalent bond that generates an electron-hole pair. when such pairs are formed in large number, a sudden increase of current is observ This type of breakdown is usually observed in zener diodes that operate in lower (6.5v or less) voltages.

Avalanche Breakdown :

If the applied reverse voltage is high free electron in the diode is accelerated. It acqu high kinetic energy. when such energetic electron

collides with the another bound electron it separates the bound electron from the bond and an electron hole pair is generated. These secondary charge carriers also get accelerated and produce additional charge carriers also get accelerated & produce additional charge carriers due to collisions. As a result carrier multiplication by Avalache process takes place. The process is very fast and junction breakdown is observed. Zener diodes having zener voltage above 10V exhibit avalanche breakdown

Q.5 Explain Principal, Construction and working of Solar cell.

→ Principle :-

solar technologies convert sunlight into electrical energy either through photovotaic CPV panels or through mirror that concentrate Solar radiation

Construction :-

A solar cell is basically a junction diode although its construction it is little bit different from conventional p-n junction diode A very thin layer of p-type semiconductor is grown on a relatively thicker n-type semiconductor. We then apply a few finer electrodes on the top of the p-types semiconductor layer.

These electrodes do not obstruct light to reach the thin p-type layer, just below

p-type layer there is a p-n junction. we also provide a current collecting electrode at the bottom at the n-type layer we encapsulate the entire assembly by thin glass to protect the solar cell. from any mechanical shock

Working :-

When light reaches the p-n junction the light photons can easily enter in the junction through very thin p-type layer. The light energy in the form at photons, supplies sufficient energy to the junction to create a no. of electron hole pairs. The incident light breaks the thermal equilibrium condition of the junction. The free electrons in the depletion region can quickly come to the n-type side of the junction

Date-04/12/2023

।। ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ।।

– शिक्षणमहर्षी डॉ. बापूजी साळुंखे

34545

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. :

Roll No. : 1608

Class : M.Sc II

Subject : Solid state physics-2

Test / Tutorial No. : open book test

Div. :

17/20

Sundeep

Q.1 Write a short note on type of Semiconduct

→ There are two types of semiconductor

a) Interinsic semiconductor with an ideal crystal structure is called as intrinsic semiconductor. Thermal energy crystal structu is called as intrinsic semiconductor. Thermal energy creates conduction electron-h pairs; for every free electron in the conductio band there is hole in the valance bond. Limited conductivity of an intrinsic semicond at room temp and under the influence of a external applied field, is due to the motion of this equal numbers of electrons & holes.

b) Extrinsic Semiconductor

When a small and controlled amount o trivalent or pentavalent element is introduce into intersic or o doped semiconductor

c) Doping :- the process of introducing a small and controlled amount of a trivalent or pentavalen element to an intrinsic semiconductor the resultin material is called as doping.

Q.2 Difference between direct & indirect bandgap.

direct Band gap	Indirect band gap
1) direct band gap is where the k vector is similar to the highest states in the valance band a for as the lowest states in the conduction band	Indirect band gap is a band gap where the maxim of the valance band maximum occur at differ value of k.
2) Efficiency is more efficient	Efficiency is well efficien
3) It directly emit a photon	It is cannot emit a photon.
4) electron rising from the valance band to the Conduction band will change the only potential.	electron rising from the valance band to the conduction band will chan ispotential as well as mom
5) Amorphous silicon & III-IV material including In as and GaAs are the example.	crystalline Si & Ge as w as same III-V material such as also are the example

3. write a short note on variation of energy band with alloy composition.

→ variation of energy bands with alloy compositi

1) fig given below illustrates the band structure of GaAs and AlAs and the way in which the bands change with composition x in the ternary compound $Al_x Ga_{1-x} As$

2) the binary compound GaAs is direct material, with a band gap of 1.43eV at room temperature

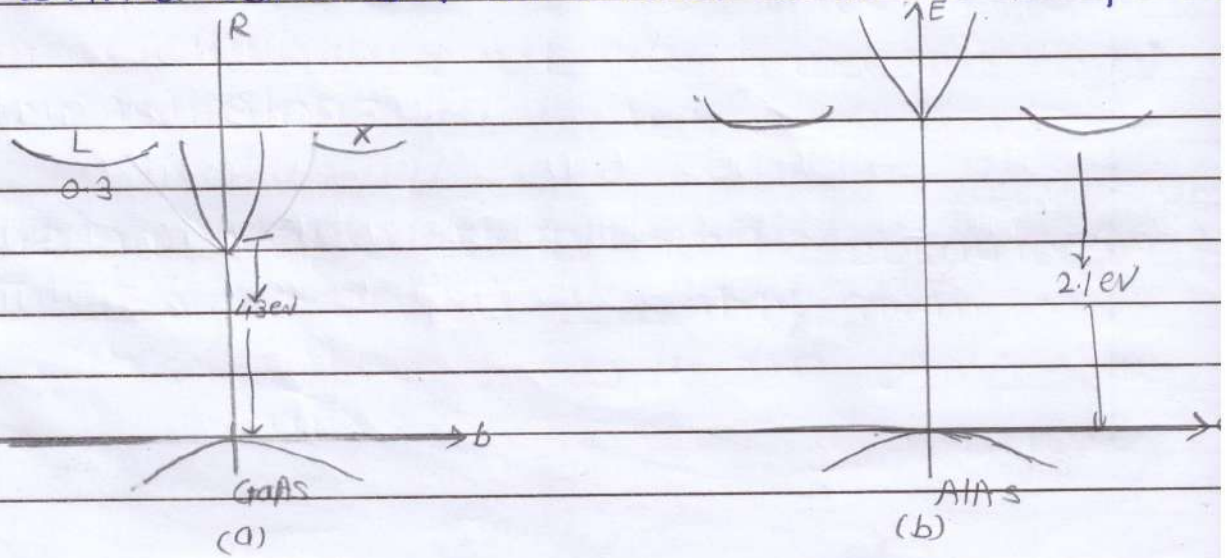
3) for refrence we call the direct (k=0) conduction band minimum.

4) There are two higer-laying indirect minima in the GaAs conduction band, but these are sufficiently above Γ that few electrons reside there.

3

5) we all the lowest-lying ~~GA~~ GaAs indirect minimum L and the other X

6) In AlAs the direct Γ minimum is much higer than th indirect X minimum and this material is therefore indirect with a band gap of 2.16 eV at room temperat



7) In the temary alloy AlxGa1-xAs all of these conducti band minima move up relative to the valance band as the composition x varies form 0.

8) However the indirect minimum Al moves up les than the other, and for compositions above about 38 present Al this indirect minimum become the lowest-lying conduction band.

9) therefore the termary alloy AlGaAs is direct semiconductor for Al composition on the column sublattice upto about 38 percent and is an indirect semiconductor for higer Al mole fracti

~~The band gap energy Eg is show in color on fi~~

।। ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ।।
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे
34576
Shri Swami Vivekanand Shikshan Sanstha Kolhapur's
VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

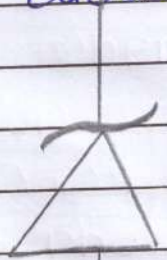
Signature of Supervisor

Suppliment No. :
Roll No. :
Class :

Subject :
Test / Tutorial No. :
Div. :

Q.4 Explain zener diode with zener and Avalance breakd

→ Many electronic circuits need dc Power Suppl A full wave rectifer Serves as good dc Power supply source. However the main disadvantages of such power supply is that the output voltage changes with the change in the input voltage or load current Hence the current hence the power supp in which the output voltage change with input - Volta or load current is called as unregulated power suppl In order to keep the output votage constand a volta regulator is connected to the power supply A zener diode is used for voltage regulation.



A diode, which is operated in reverse breakdown region, is call as zener diode.

A zener diode has precies breakdown voltage ranging from 3 to 200 V

fig. zener diode: electric Symbol.

Zener breakdown:- the applications of reverse bias voltage across the depletion region creates an electric filed of the order of 3×10^{15} V/cm. This electric filed exerts a force on the valance electron and breaks down the covalent bond that generates an electron hole pair when such pair are formed in large number, a sudden increase of current observed. This type of breakdown is usually obseeved in zener diodes that operate in lower voltage.

Avalanche breakdown:- If the applied reverse voltage is high free electron in the diode is accelerated. It acquires high kinetic energy when such energetic electron collides with the other bound electron it separates the bound electron form the bond an electron hole pair is generated these secondary charge carries also g accelerated and produce additional charge carrier due to collision As the result carrier multiplicat by Avalanche process take place the process is very fast and junction breakdown is obseeved

Q.5 Explain principle construction and working of solar cell

→ principle:- solar technologies convert, sunlight into electrical energy either through photovolaic (PV) panels or through mirror that concerittrate solar radiation

Construction:-

A solar cell is basically a junction diode at through it's construction it is little bit diffrenent type of ~~p form~~ p-type semiconductor is grown on a relatively thicker n-type semicondur when a apply a few finer electrodes on the top of the p-type semiconductor layer

These electrodes do not abstruct light to the thin p-type layer just below P-type layer there is a p-n junction we also provid a current collecting electrode at the bolton of n-type layer we encapsulate the entire assemble by thin glass to protect the solar cell from mechanical shocks

working:-

when light reaches he p-n junction the light photons can easily entre in the junction through very thin p-type layer light energy in the form at photons, suplies sufficient enery to junction to creats a no of electro hole pairs. The incident light breaks the thermal equilibrium conduction of junction The free ectron in the deplection region can quickly come to the n-type solid to the junction.

।। ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ।।
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे
34557
Shri Swami Vivekanand Shikshan Sanstha Kolhapur's
VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

Snehal Nitin Ahiwale

Suppliment No. :

Roll No. : 1601

Class : Msc II

Subject : SSP II

Test / Tutorial No. :

Div. :

17/20

Q. Write a short note on types of semiconductor.

Ans: There are two types of semiconductor.

a) Intrensic semiconductor

(1) The density in intrensic of holes and electron is eq

(2) They are pure semiconductor.

(3) Electrical conductivity is low.

(4) Intrensic semiconductor depends on temp only.

b) Extrensic Semiconductor.

3 (1) In Extrensic semiconductor ipurities are added.

(2) Density of holes is not equal to density of electrons.

(3) Electrical Conductivity is hight

(4) Depend on temperature as well as amount of impurity.

(5) Trivalent & Pentavalent impurities are added.

Q2) Difference between direct & indirect bandgap.

Direct Band Gap	Indirect band gap
Direct band gap is where K vector is similar to the highest states in the valence band a far as the lowest state in the Conduction band.	Indirect band gap is a band where the maxim of the valence band and minimum occur at diffe values of K
Efficiency is more efficient	Efficiency is less efficien
It can directly emit a photon	It cannot emit a photon.
Electron rising from the valence band to the conduction band will change its potential as well as momentum	Electron rising from the valenc band to the conduction ban will change its potential as well as.

Q3) Write a short note on variation of Energy bands with Alloy composition.

Ans: ① Fig given below illustrates the band structure GaAs and AlAs and the way in which the ba change with composition x in the ternary compou

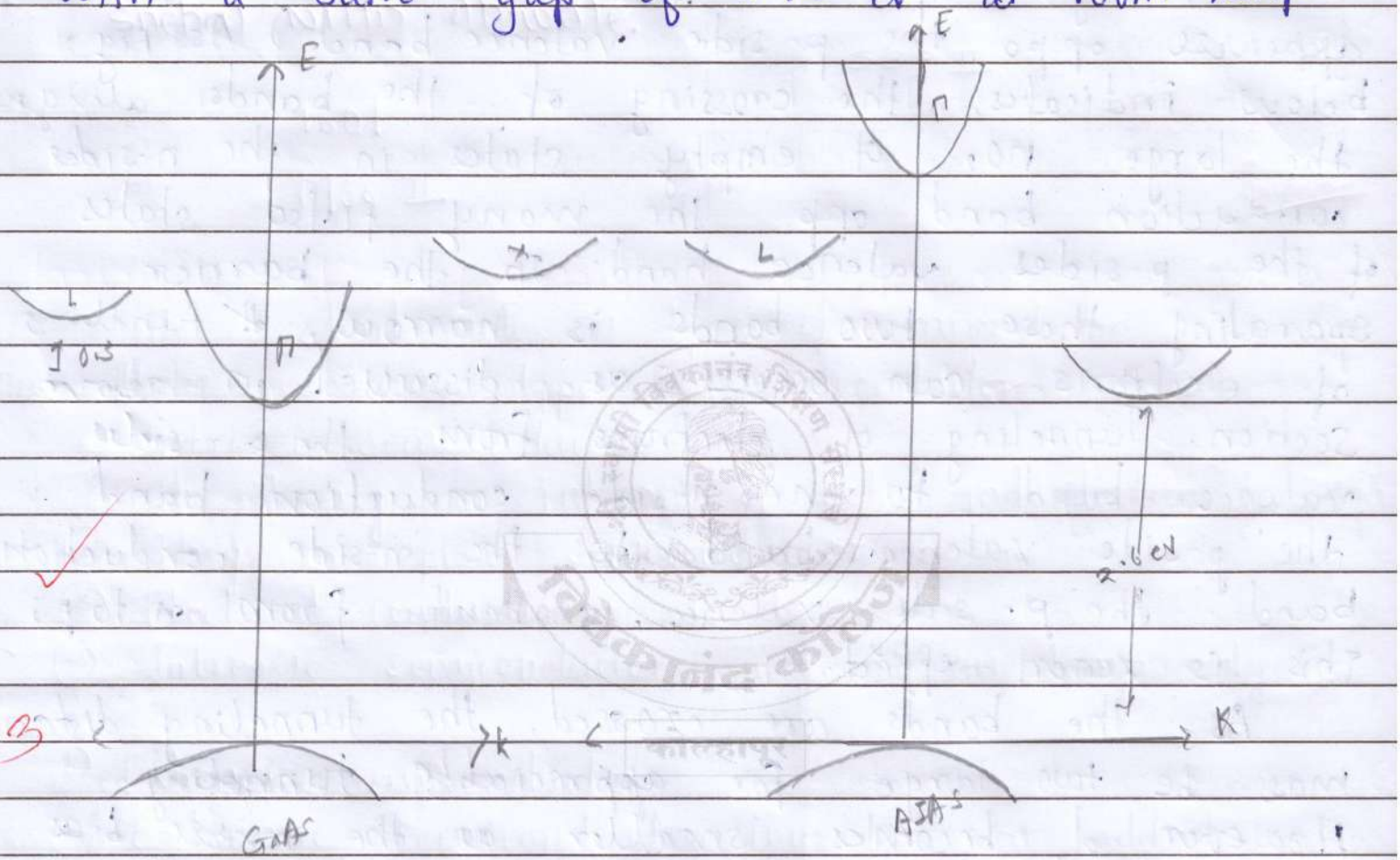
② The binary compound GaAs is a direct material with a band gap at 1.43 ev at room temp

③ For reference, we call the direct ($K=0$) conduction band minimum Γ.

④ There are also two higherlying indirect minima in the GaAs conduction band but there are sufficiently far above Γ that few electron reside there.

5) We call the lowest lying GaAs indirect minimum L and the other X.

6) In AlAs the direct Γ mimimum is much higher than the indirect x minimum and this material is therefore indirect x minimum and this indirect with a band gap of 2.16 ev at room temp.



7) In ternary alloy $Al_xGa_{1-x}As$. As all of these conduction band minima move up relative to the valence band as the composition x varies from 0 (GaAs) to 1 (AlAs).

8) However, the indirect min All moves up less than the others, and for compositions above about 45 percent Al this indirect minimum becomes the lowest lying conduction band.

Q4) Explain Zener diode with Zener & Avalanche breakdown.

Ans: Zener breakdown:

When a heavily doped junction is reverse biased, the energy becomes cossed at relatively low voltages (ie. the n-side conduction band appearse oppo the p-side valence band) As Fig below indicates, the crossing of the bands alng the large no, of empty states in the n-sides conduction band opp the many filled states of the p-sides valence band. If the barrier separating these two bands is narrow, # tunelin of electrons can occure as disscussed in above section. Tunneling of electrons from the p-sides valence band to the n-side conduction band the p-side valence band to the n-side conductio band the p-side valence, comrent from n to p This is zener effect.

As the bands are crossed, the tunneling dista mass be two large for appreciable tunneling However d becomes smaller as the reverse bias is increased ~~becomes small~~ because the higher electric fields results in steeper slops for the band edges. This assumes that the transistion region with W does not increase appreciably with reverse bias. For low voltages and heavy doping on each side of the junctio this is a good assumption. However, if zener breakdown does not occur with reverse bias of a few volts avalanche breakdown will become dominant.

Q5) Explain principal, construction & working of solar cell.

Ans: Principle: Solar technologies convert sunlight into electrical energy either through photovoltaic (PV) panels or through mirrors that concentrate.

Construction:

A solar cell is basically a junction diode, although its construction it is little bit different from conventional p-n junction diodes. A very thin layer of p-type semiconductor. We then apply few finer electrodes on the top of the p-type semiconductor layers.

This electrodes do not obstruct light to reach th thin p-type layer. just below p-type layer there is a p-n junction. We also provide a current collecting electrode at the botton of the n-type layer we encapsulate the entire assemble by thing glass to protect the solar cell, from mechanical shock.

Work:

When light reaches the p-n junction, the light photon can easily enter in the junction through very thin p-type layer. The light energy, in the form of photons, supplies sufficient energy to the junction to create a no. of electron hole pairs. The incident light breaks the thermal equilibrium condition of the junction. The free electrons in the depletion region can quickly come to n-type side of the junction.

।। ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ।।
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे
34549
Shri Swami Vivekanand Shikshan Sanstha Kolhapur's
VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

Biradar Anand Nagappa

Suppliment No. :

Roll No. : 1603

Class : MSc-II (Physics)

Subject : SSP II

Test / Tutorial No. :

Div. :

16/20

Q1 Write a short note on type of semiconductor.

→ a) Intrensic semiconductor

① The dencity in intrensic holes and electrons is equal.

② They are pure semiconductor.

③ Electrical conductivity is low.

④ Intrensic semiconductor depends on temperature only.

3

b) Extrensic semiconductor.

① Extrensic semiconductor impurities are added.

② Density of holes is not equal to density of electrons.

③ Electrical conductivity is high.

④ Depend on temp as well as amount of impurity

⑤ Trivalent and pentavalent impurity.

Q2 Difference between direct and indirect band gap

Direct Band Gap	Indirect band Gap.
Direct band gap is where k vector is similar to the higest status in the valence band a fas as the lowest state in the conduction band.	Indirect band gap is a band where the maximum of the valance band and minimum occuse at differe values of k.
Eifficiency is more efficient	Eifficincy is less efficien
Electron rising from the valance band to the conduction band will change its potential as well as momentum.	Electron rising from the valance band to the conduction band will chan its potential as well as

Q3. Write a short note on variation of energy ba with Alloy composition

Ans. ① Eig given below illustrates the bond struct of GaAs and AlAs and the way in which th band change with composition x in the ternary compond

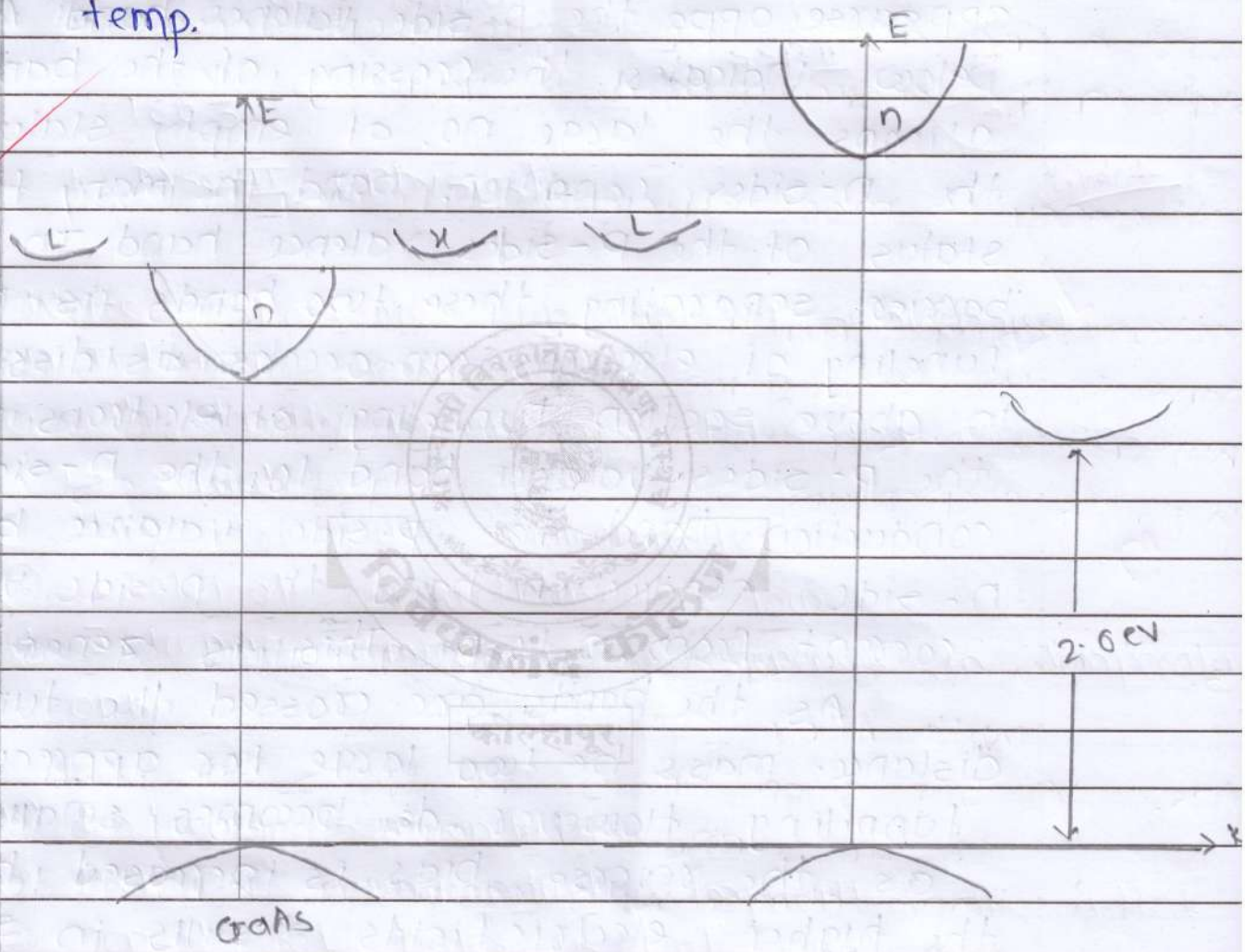
② The binary compond GaAs is a direct mater with the band gap at 1.43 ev at room te

③ for reference we call the direct (k=0) condition band minimum. Γ

④ There are also two higherlying indirect minri in the GaAs condition band but there sufficienty far above Γ that few electron reside there.

⑤ We call the lowest lying GaAs indirect minimu L and the other X.

⑥ In AlAs the direct Γ minimum is much higher then the indirect X minimum and this material is therefore indirect X minimum and this indirect with a band gap of 2.16 ev at room temp.



⑦ In ternary alloy AlxGo8xAs all of these condit band minima move up relative to the valance band as the composition x varia from 0(GaAs to (AlAs)

⑧ However the indirect min All moves up less th the others and for compositions above about percent Al this indirect minimum becomes the lowest lying conduction band.

Q 4) Explain zener diode with zener and Avalanch breakdown.

Ans: zener breakdown

When a heavily doped junction is reverse biased the energy becomes cossed at relatively low voltage cip the n-side conduction ban appearse oppo the p-side valence band As fig below indicates the crossing of the bands alingns the large no, of empty states in the n-sides condition. band the many filled status of the p-sides valence band In the barrier separating these two bands is narrow funeling of electrons can occors as disscused in above section tunneling of electrons from the p-sides valance band to the n-side conduction band the p-side valance band t n-side conduction band the p-side valence corrent from n to pi This is zener effect

As the bands are crossed the tunneling distance. mass be too large for appreciable tunniling however de becomes smaller as the reverse bias is increased because the higher electric fields results in steeper splops for the band edges. This assumes that the transistions region with w does no increase appersciably with reverse bias for low voltages and heavy doping on each side of the junction this is a good assumpt however sp zenar breakdown does not occers with reverse bias of a few volts avalanche breakdown will become dominant

34559

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

Suppliment No. :

Roll No. :

Class :

Subject :

Test / Tutorial No. :

Div. :

Q5 Explain principal, construction and working of solar cell.

Ans: principal : solar technologies cannot sunlight into electrical energy either through photovoltic (PV) panel through mirror that concentrat

construction:

A solar cell is basically a junction diole although its concentration it is little bit diffused from conventional p-n junction diodes A very thin layer of p type semicond we then apply few finer electrods on th top of the p- types semiconductor layers.

This electrodes do not obstruct light to reach the thin p -type layer just below p-ty layer these is a p-n junction we also provides a current collecting electrode at t bottom of the n-type layer we encapsulate the entire assemble by thing glass to proted the solar cell from mechanical shock

Work

When light reaches the p-n junction the light photon can easily enter in the junctio through very thin p- type layer. The light energy in the form of photons supplies sufficient energy to the junction to creat a no of electron holes pair the incident light brakes the thermal equilibrium condition of the junction the free electron in the depletion region can quickly conve to n+ type side of the function.

D:- 4/12/2023 Shivaraj Chandrakant Kavalagi

।। ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ।।
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे 34562
Shri Swami Vivekanand Shikshan Sanstha Kolhapur's
VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

Suppliment No. :
Roll No. : 1606
Class : TA.SC-II

Subject : Solid State Physics - II
Test / Tutorial No. : Open Book Test
Div. :

18/20

Q1

i) Write a short note on Types of semiconductor

→ There are two types of semiconductor
a) Interinsic semiconductor b) Extransic conductor

a) Intrinsic semiconductor :-
A pure perfect semiconductor with an ideal crys structure is called as semiconductor. Thermal energy creates conduction electron-hole pairs; for every free electron in th conduction Band there is hole in valence Band. Limited conductivity of an interinsic semiconductor at roo temperature & under the influences of an external applied electric field is due to the motion of these equ numbers of electrons & holes.

b] Extrinsic semiconductor :-
When a small & controlled amount of a trival or pantavalent element is introduced into an intrinic semiconductor, the resulting material is called as extrinsi or a dopped semiconductor.

c] Doping :-

The process of introducing a small & controlled amount of trivalent or pentavalent element to an intrinsic semiconductor is called doping

Types of Extrinsic semiconductor :-

There are two types of extrinsic semiconductor

a) N-type semiconductor

b) P-type semiconductor.

Q 2 Differentiate between Direct band & Indirect band Gap

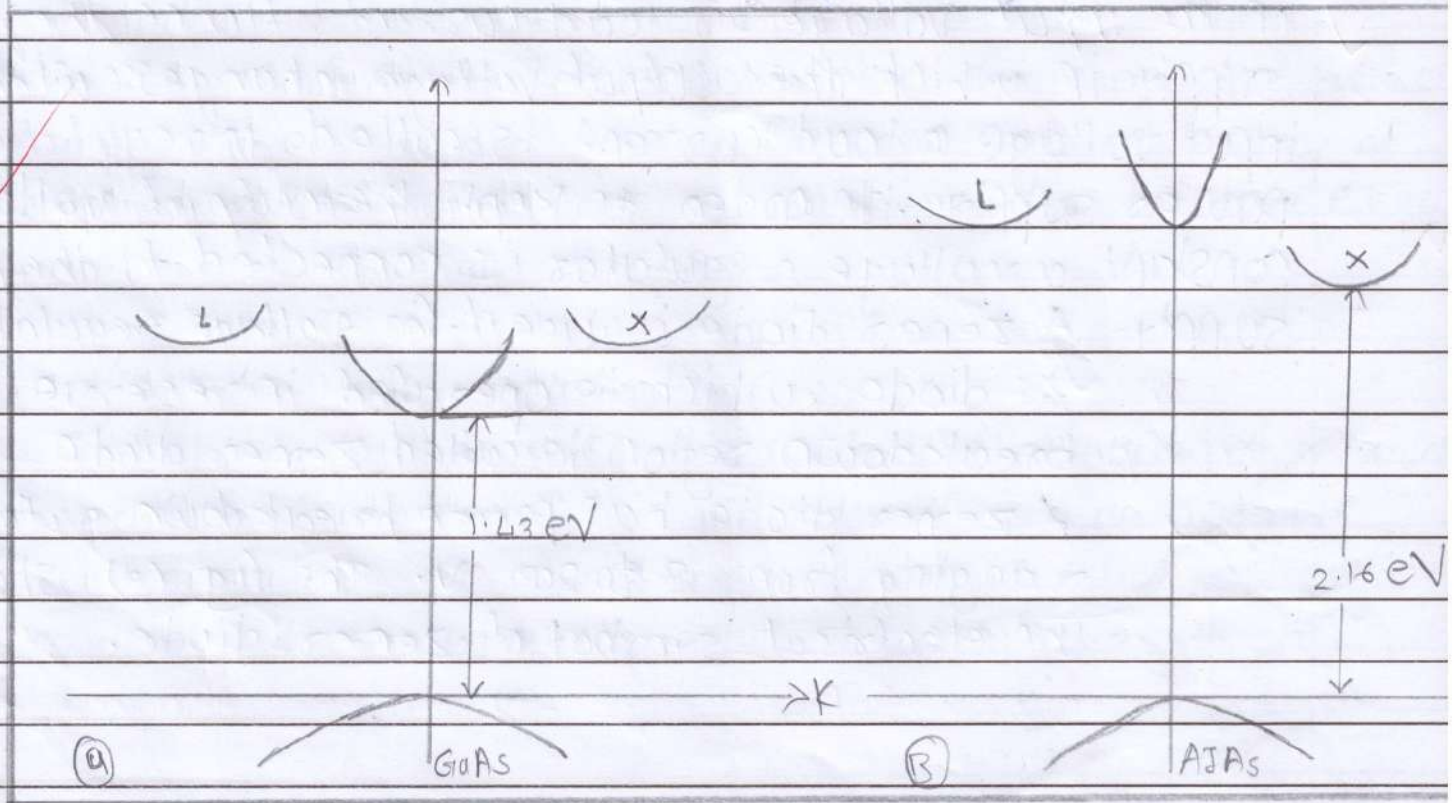
Direct Band Gap	Indirect Band Gap
1) Direct Band gap is where the K-vectors is similar to the highest states in the valence Band for as the lowest states in the C.B	1) Indirect Band gap is a bar gap where the max of the va band minimum occur at different values of K.
2) efficiency is more efficient	2) effeciency is less efficient
3) It can directly emit a photon	3) It cannot emit a photon.
4) electron rising from the valence bond to the C.B will change the only potential	4) electron rising from the valence bond to the C.B w change the potential as we momentum.
5] Amorphous silicon & III IV materials in as & GaAs	5) Crystaline si & Ge as well a III-IV material Also are. ex

Q3 Write a short note on variation of Energy Band with Alloy composition

→

variation of energy Bands with Alloy composition.

- Given Below illustrates the band structure of GaAs & AlAs & the way in which the band change with composition x in the ternary compound $Al_xGa_{1-x}As$.
- The Binary compound GaAs is a direct material, with a band gap 1.43 eV at room temp.
- For reference, we call the direct (k=0) conduction Band minimum Γ.
- There are also two higher-laying indirect minima in the GaAs conduction Band, but these are sufficient far above Γ, that few electron reside there
- we call the lowest-laying GaAs indirect minima L & the other X.
- In AlAs the direct Γ minimum is much higher than the indirect X minimum, & this material is therefore indirect with a band Gap of 2.16 eV at room temp.



• In the ternary alloy $Al_xGa_{1-x}As$ all of the these conduc
Band minima move up relative to the valence band a
the composition x. Varies from 0 (GaAs) to (AlAs)
• However the indirect minima Δ move up less tha
the other 4 for compositions above about 38 percent
this indirect minima becomes the lowest laying conduct
band
• there for the terminary alloy AlGa As is a direct
semiconductor of Al composition on the column III
subtitle up to above 38 percent it is an indirect
semiconductor for higher Al mole fractions.
• The band gap energy Eg is shown in colour

Q 4 Explain zener diode with zener & avalanche break

→ Many electronic circuit need dc power supply. A fu
wave rectifire serves as a good dc power sourc
However, the main disadvantages of such power sup
is that the output voltage changes with the change
in the input voltage or load current. Hence the po
supply in which the output voltage changes with
input voltage or load current is called unregulated
power supply. In order to kept the output voltag
constant a voltage regulator is connected to the po
supply A zener diode is used for voltage regulatio

A diode, which is operated in reserve breakdown region is called Zener diode
A zener diode has prise breakdown voltage ranging from 3 to 200 V. The fig (a) shou the electrical symbol of zener diode.

(a)

।। ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ।।
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे 34572
Shri Swami Vivekanand Shikshan Sanstha Kolhapur's
VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. : - 7
Roll No. :
Class :

Subject :
Test / Tutorial No. :
Div. :

Zener breakdown :-

The application of reverse bias voltage acrosss the depletion region creates an electric field of the order of 3×10^5 V/cm. this electric field exer field a force on the valence electron & breaks down th covalent bond the generates an electron hole pair. Whe such pairs are formed in large no. a sudden increase of current is observed the type of breakdown is usual observed in zener diode that operates in lower volt

Avalanche breakdown :-

If the applied reverse voltage high free electron in the diode is accelerated. It degu high kinetic energy. when such energetic electron collides with the another bound electron. it separate bound electron from the bound & an electron hole pai is generated. These secondary charge carries also get accelerated & produce additional charge carries due collisions. As a result carries multiplication by Avala process takes place. The process is zener vo very f & junction breakdown is observed. Zener diodes

having zener voltage above 10V exhibit avalanc breakdown.

Q5 Explain principle construction & working of solar cel

→ Principle :- solar technologies convert sunlight into electrical energy either through photo voltic (PV) panels through mirrors that concreated solar radiation

Construction :-

A solar cell is basically a junction dio although is its construction it is little bit different fr coventional p-n junction diodes. A very thin layer of p-type semiconductor is grown on relatively thic n-type semi conductor. we then apply a few linear electrodes on the top of p-type semiconductor layer. These electrodes do not abstruct l to reach the thin p-type layer, just below p-type layer there is a p-n junction. we also ~~private~~ pro a current collecting electrode at the bottom of the n-type layer we encapusulate the entire assembly b thin glass to protect the solar cell from any mechanic shock.

3

Working :-

When light reaches the p-n junction, t light photons can easily enter in the junction thro very thin p-type layer. The light energy in the fo of photons, supplies sufficient energy to the junction create ano. of electron hole pairs the incident l breaks the thermal equillibrium condition of the junctio

The free electrons in the depletion region can quickly come to the n-type side of the junction.