Notice

Date: Monday, 28 January 2019

It is hereby informed to the students of M.Sc. – I and II, that Second Term Internal Evaluation Examination is scheduled between 8th to 9th February 2019 in the Department of Physics.

Instructions:

1) Nature of question paper for M.Sc. – I: 05 MCQ's (05 Marks), 01 Short Answer Questions (05 Marks), 01 Long Answer Questions (10 Marks)
2) Nature of question paper for M.Sc. – II: 05 MCQ's (05 Marks), 01 Short Answer Questions (05 Marks), 01 Long Answer Questions (10 Marks)
3) Students should present before 15 minutes of the examination.
4) Answer sheets will be provided by the Department.
5) Strictly mention the Full Name and Roll number on Answer Sheet correctly.
6) All students should remain present for the Internal Examination as the examination will not be conducted afterword's in any case.

Sr. No.	Date	Class	Name of the Paper	Time
01	08/02/2019	M. Sc. – I	Quantum mechanics- II	11am – 12 noon
			Statistical mechanics	12 noon – 01 pm
02	08/02/2019	M. Sc. – II	Experimental techniques	11am – 12 noon
			Electronic devices and applications	12 noon – 01 pm
03	09/02/2019	M. Sc. – I	Electrodynamics	11am – 12 noon
			Atomic and Molecular Physics	12 noon – 01 pm
04	09/02/2019	M. Sc. – II	Solid State Physics- III	11am – 12 noon
			Solid State Physics- IV	12 noon – 01 pm

HOD, Physics
Head of Physics
Department of Physics
Vivekanand College, Kolhapur.

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-Shikshanmaharshi Dr. Bapuji Salunkhe
Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

M.Sc. Part-II SEM II Internal Examination (2018-19)
Experimental techniques

Time - 11:00 am - 12:00 pm Total Marks: 20

Instructions:-
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of log table and calculator is allowed.

Q.1Choose the correct alternative and rewrite. **(05)**

1. In gases, the magnitude of ionization current depends on ..... of the gas.
   a) Pressure b) volume c) temperature d) kinetic energy

2. In ..... gauge, the resistance of wire with temperature and pressure is measured by Wheat stone bridge consequently.
   a) Pirani b)McLeod c) Penning d) all of these

3. Maximum power density can be calculated by.....
   a) maximum power per unit length b) maximum power per unit area
   c) maximum power per unit volume d)) none of these

4. Wind energy is the manifestation .....
   a) heat energy b) geothermal energy
   c) solar energy d) mechanical energy

5. India's potential for electrical power from wind power is.....
   a) negligible b) 50MW
   c) 20000 MW d) 100 MW

Q.2 Attempt any one **(10)**

1. Describe principle, construction, working and characteristics of sputter ion pumps.

2. Write short note on thermal conductivity gauges and Describe construction, working and uses of Pirani gauge.

Q.3 Attempt any one. **(05)**

1. Briefly explain the concept of leak detection.

2. Explain the applications of vaccum technology.

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Shri Swami Vivekanand Shikshan Sanstha's
Vivekanand College (Autonomous) Kolhapur
Department of PhysicsM.Sc. II
2018-19
Attendance Sheet
Paper: Experimental Technique
Date:08/02/2019

Roll. No.	Name of Candidate	Sign
1	Aswale Nikhil Mohan	Aswale
2	Bachate Prajakta Ramchandra	Pbac
3	Deshmukh Namita Prataproa	N.P.D.
4	Ghadage Sachin Subhash	Ghadage
5	Jadhav Anmol Narendra	Jadhav
6	Jangid Saroj Nemichand	Jangid
7	Kamble Karan Mukund	Kamble
8	Khan Anjum Ibrahim	Khan
9	Mane Rajalaxmi Sanjayrao	Rmane
10	Mulla Shahanwaj Barkatali	MDN
11	Nalawade Priyanka Mansing	Priyanka
12	Patnkar Shivrsaj Mansing	Patankar
13	Pathak Onkar Herambraj	Pathak
14	Patil Nirmala Vilas	N.V.Patil
15	Patil Rasika Chandrakant	Rasika
16	Pawar Pooja Gunvant	Pawar
17	Phadatare Pooja Sunil	PPS
18	Salunkhe Abhishek Chandrashekhar	Salunkhe
19	Shirage Pravin Ramchandra	Pravin
20	Sid Shraddha Arun	Sid

॥ ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ॥
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे

27832

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

Suppliment No. :

Roll No. : 1332

Class : M.Sc - II

Subject : Experimental techniques

Test / Tutorial No. :

Div. :

I ① positive displacement

② both (a) and (b)

③ 10^{-6} torr

④ Perpendicular

⑤ ~~visible~~ IR

05

2. (2) Diffusion pump -

The Diffusion of pump commely used to creating heat vaccum to the indstrial vaccum pump.

The diffusion pump vaccum potential rang is 10^{-12} mbar.

The diffusion pump is made up with stenless steel.

In this diffusion pump three varyes size of cone shaped pressure jet is present.

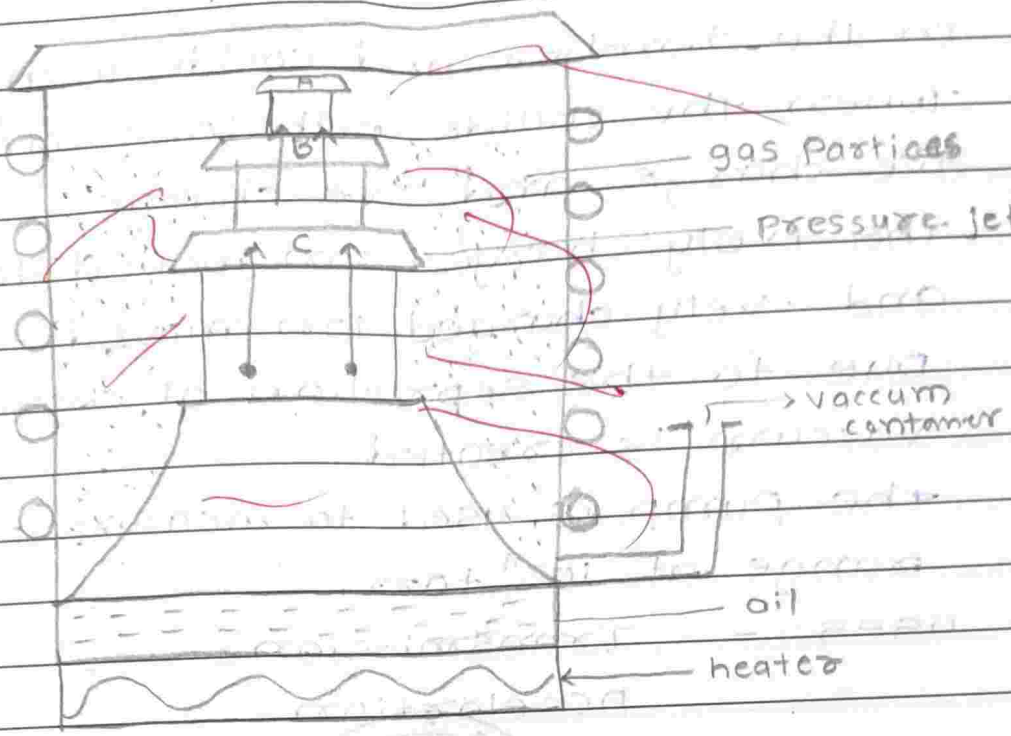
The cone is larger and decrease the size in the upward direction.

The exited gas are travel for upward direction and exit in the pressure jet.

The wall of the chamber is usually coold and the gas moleules are reaches in the wall of chamber then immditely the gas retrun in the liquid state.

The lower side of the chamber is present oil drips.

The chamber was heated by the silecon in the downward the chamber.



Suptter ion pump -

The suptter ion pump is gas captured pump.

The pump is ionized by combination of electric and magnetic field.

In the sputter ion pump used two electrodes cathod and aniode. the magnetic anode is made by stainelss steel.

The cathod is made up with the titanium.

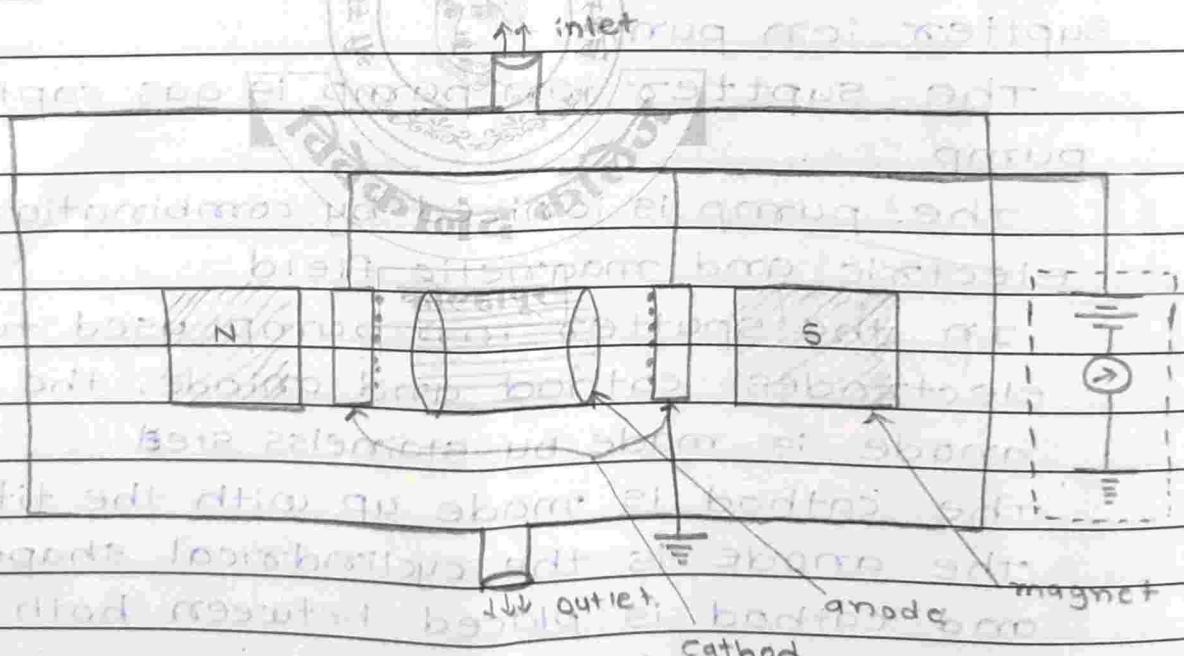
The anode is the cyclindrical shaped and cathod is placed between both side of the anode.

The magnetic ~~feild~~ field is oriented by the axis of anode.

when electric field is applyed to the cathod the electronces are get exited state in the presence of magnetic field and they moves.

In the chamber and collide with ions.
When the collide with ions are formed
+ve charge and - ve charge
The +vely charged ion moved to the cathod
and -vely charged ion moved to the anode
Due to the sepration of charge the
vaccum is created.
The pump is used to measure pressure
range at 10^{-11} torr.

uses - Transmission
Accelartion.
semiconducter material equipment.



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Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Name- Aishwarya Suryakant Gaikwad.

Suppliment No. : 1.

Roll No. : 1334

Class : M.Sc II.

Subject : Exprimental Techniques.

Test / Tutorial No. : 2.

Div. : -

Que.1.

1) positive displacement.

2) both (a) and (b).

3) 10^{-6} torr.

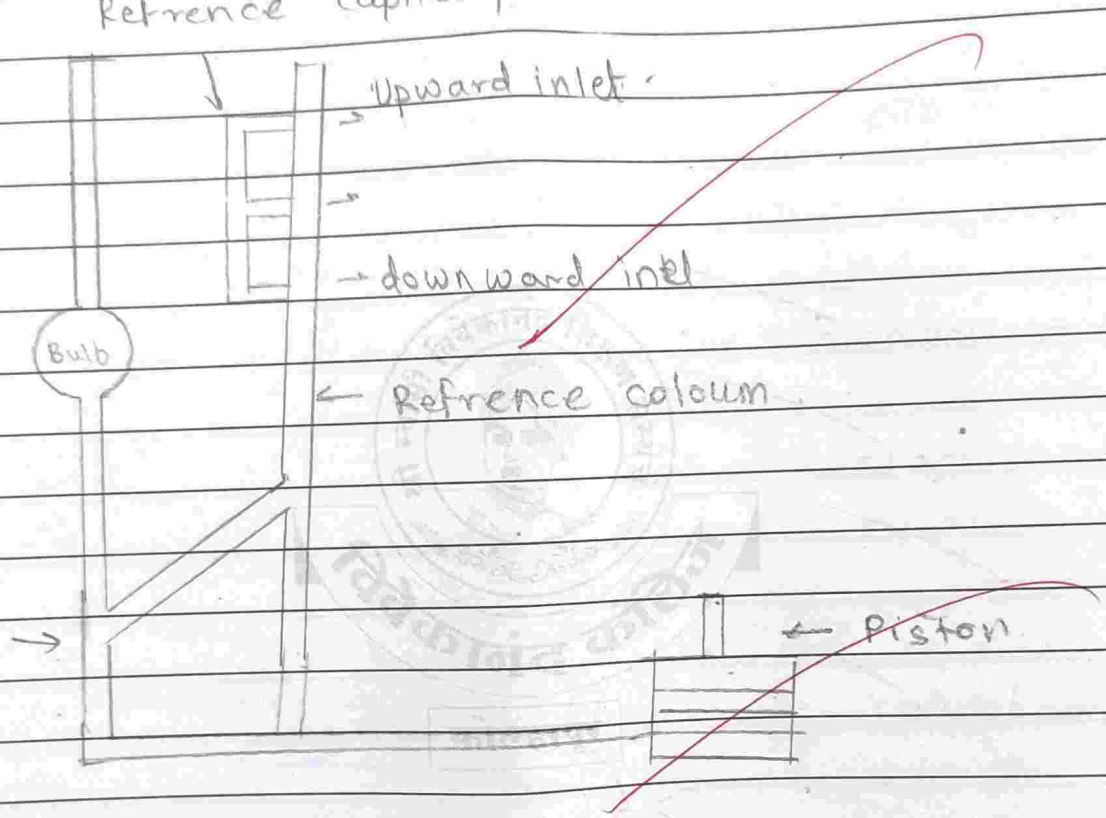
4) perpandicular.

5) Visible. 0½

2)

1) McLeod →

- The McLeod gauge is working on a principle of a Boyel's law.
- Following figure shows construction of McLeod gauge.



Working →

- ~~It is a~~ When the position of Liquid mercury is on cut off post.
- The

- First Remove gas in bulb with help of mecury which is point toward upward direction.
- After remove in the gas mercury is in pass into a bulb with help of ~~higher~~ Helium.

Hence the applied of mercury is moved in

direction with the help of palladium.
- The mercury ~~redonal~~ return to the tude which is in the gas inlet.
- ~~It moment~~
- It manage to have potential between initial and final position.
-

Construction →
- When a rotator mercury is an position of cut off point.
- The mercury surface is Have Hollium feidd on it.
- When mercury remove portion goes in upward direction.

1) Mercury Resonance →
- Mercury Resonance is filled with Hg gas.
- It's one end is connected to the ~~bulb and~~ cut off point and other on piston.

2) Referance capillary →
Both ends are connected to the referance coloum which is connected to a measuring canal.

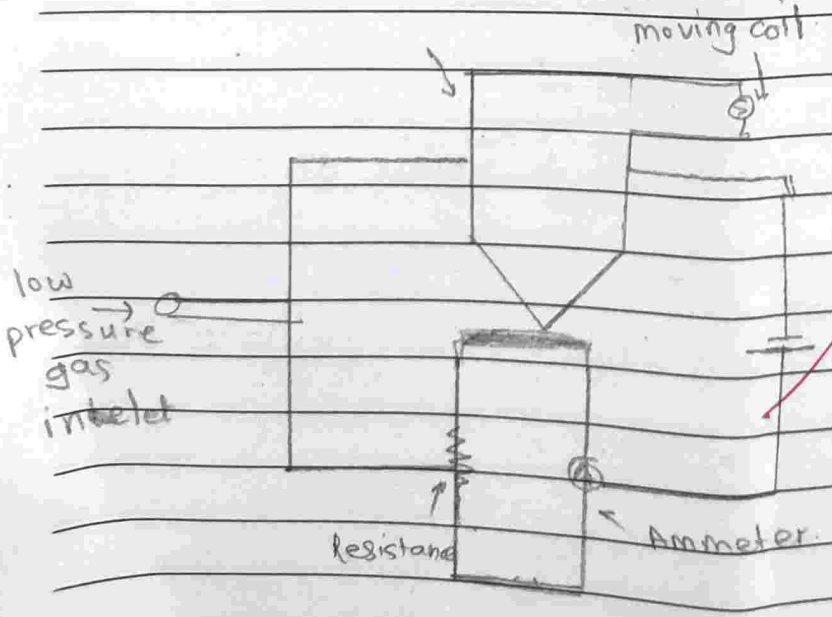
3) Referance coloum →
Referance coloum is is a tube which shows direction of flow.

4) Bulb → bulb ~~shows~~ Contain vaccum and it also replace by He and Hg gas.

Derivation of McLeod Gauge →

We can derive eqn for McLeod gauge where we.

Que 3) Thermocouple gauge



1) Thermocouple gauge is is a gauge which is working on thermo effect which is shows connection between Hot and cool junction.

2) Th thermocouple gauge we apply electricity on feild.

06

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Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 1
Roll No. : 1335
Class : MSc-II

Subject : Experimental Technique
Test / Tutorial No. :
Div. :

1

i)
→ positive displacement

ii)
→ both (a) & (b)

iii)
→ 10^{-6} torr

iv)
→ indirectly ✗

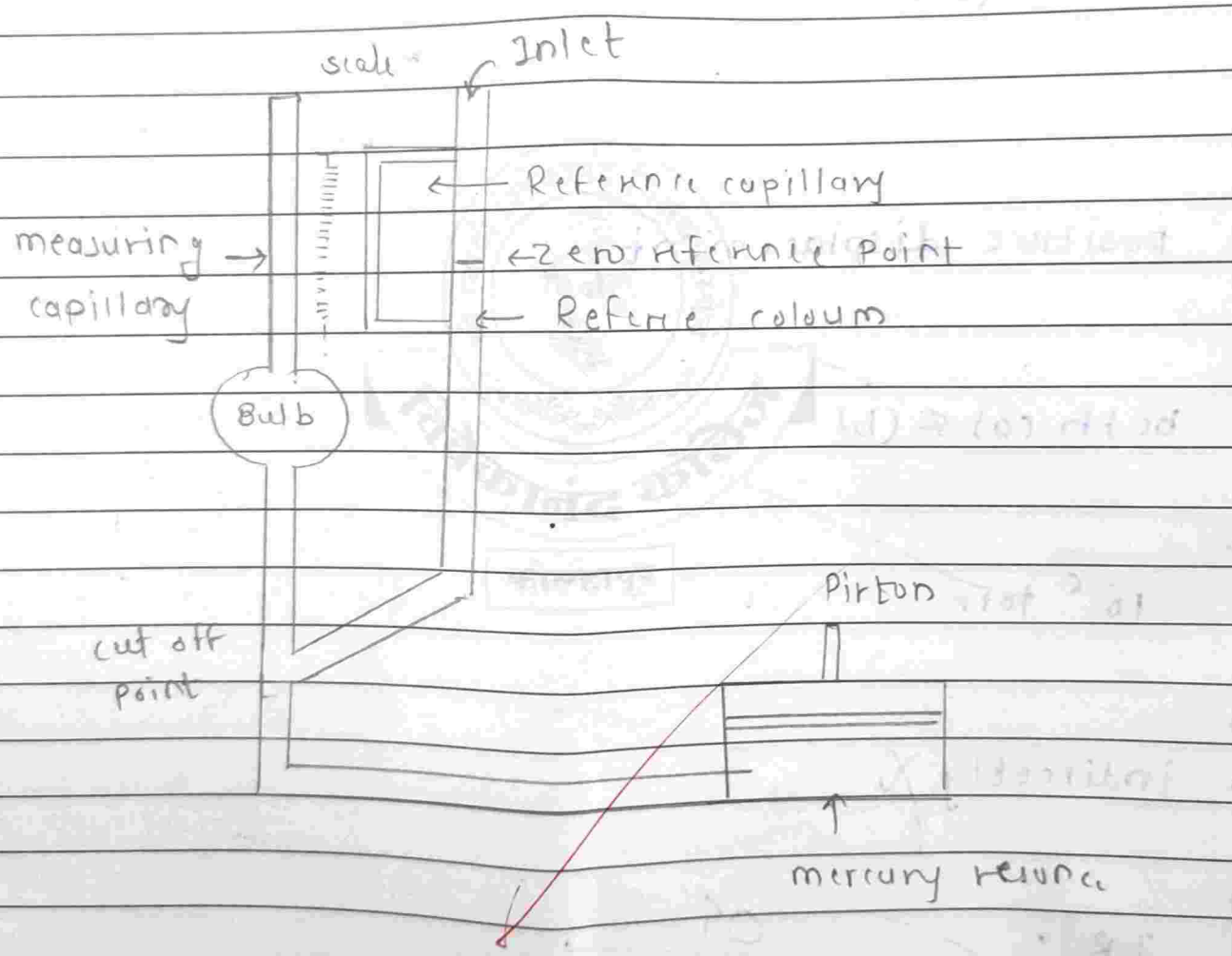
v)
→ IR ~~—~~ Of

i>

→ Mcleod gauge

The mcleod gauge on the principle of Boyle low.

Experimental Diagram of mcleod gauge.



construction:-

The mcleod gauges on work on the principle of Boyle low.

① Working field ;-

① When the store mercury is on the piston in cut off poit.

② The mercury inlet on the surface of mercury resonce

③ The mercury will be remove by bulb than pirton move upword diraction

② Mercury Resonce ;-

① mercury resonce store ~~mer~~ Hg gas

② one end is contted to cut off point & anoth end will be Pirton

③ Reference capillary ;-

① Both ends are connected in the reference coloum

② which is closer to measuring capillary

④ Reference coloum ;-

① The reference coloum one end conneted to cut off point and anothe end will be inlet gas

② Refere coloum is parallel to measuring capillary.

⑤ Bulb ;-

① one end connected to the cut off point & another end will be scale.

② Bulb which detect pressure on the tube

⑥ measuring capillary ;-

① one end on scale & other end will be cut off point

② measurin capillary has measure high differen mercury

Working:-

① first to remove the gas in bulb with the help of cut off point on the mercury resonce which Piston moves in upword.

② The gas remove on bulb then Hg as pass on the bulb which the help of the ~~capt~~ resonce capillary this gas pass on ~~bulb~~ bulb than mercury resonce of Piston move on the ~~th~~ downword diraction

③ The ~~capitt~~ mercury resone of tube which work on the gas inlet.

④ It measure the potential differnce ~~bet~~ between in initial an final presuu

⑤ The Boyles low can be find on the pressue of capillary

Derivation of mcleod ~~ditai~~:-

If P_1V_1 be the initial ~~produ~~ ← P_2V_2 be the final volum ~~of the~~

Boly's low

$$P_1V_1 = P_2V_2 \quad \text{— (1)}$$

P_1 → pressue of initial
P_2 → pressu of final
v_1 → volume of initial
V_2 → volume of final
h → highb on the

Now initial volta,

$$V_1 = v_1 + ah \quad \text{— (2)}$$

final volta,

$$V_2 = v_2 + ah. \quad \text{— (3)}$$

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SUPPLIMENT

Signature of Supervisor

Suppliment No. : ~~1335~~ 2
Roll No. : 1335
Class : MSc II

Subject :
Test / Tutorial No. :
Div. :

$P_2 = P_1 + h \quad \cdots (5)$

~~$P_2 \Rightarrow$~~

$P_1V_1 = P_2V_2$

$= (P_1+h)(V_2+ah)$

$= P_1(V_2+ah) + h(V_2+ah)$

$= P_1V_2 + P_1ah + V_2h + ah^2$

$= \cancel{(P_1+h)ah}$

$P_1V_1 - P_1ah = ah^2$

Or $P_1V_1 - P_1ah = ah^2$

$P_1 = \frac{ah^2}{(V_1 - ah)}$

But $V_1 - ah \approx V_1$

$P_1 = \frac{ah}{V_1}$

$$P_1 = \frac{\pi h}{V_1}$$

This is the derivation of mcleod gauge

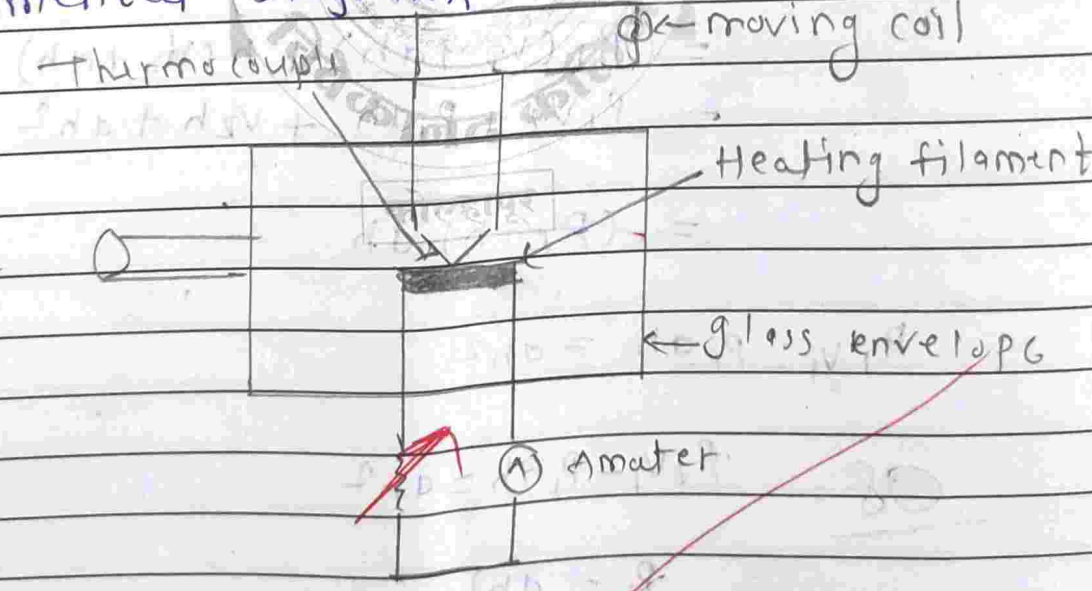
Q3

(1)

→ thermocouple gauge.

The thermocouple gauge is an the basic principle of therdynomic stades that at low pressure them at low conductity decreas with decreasing pressure

Experimental Diagram:-



Thermocouple gauge to measure the pressure

construction :-

① This consits thermocouple & Heating filament on the the thermocouple gauge.

② The low pressure of gas an inlet & current measur in the moving coil.

③ The Heating filament which is contred to the center of thermocouple

④ Amater which give current mainted

Working :-

① The Heating wire which is contained of tangustan wire. which is connect to the center of thermocouple

② The current pass throught Heating filament gives tangustan wire will be heated than current transfer for moving coil.

③ moving coil is outlet of the thermocouple and low pressure gas in inlet of this gauge.

④ The current modified in glass envelope.

⑤ The thermocouple gauges has measure the pressure.

⑥ The

of

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Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

M.Sc. Part-II SEM IV Internal Examination (2018-19)

SSP 3 : Physical Properties of Solid

Time - 11:00 am - 12:00 pm Total Marks: 20

Instructions:-

1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of log table and calculator is allowed.

Q.1. Choose correct alternative **(5)**

1. In colour centre defect of crystal there is excess of …….. Ion.
   a) Metalloid b) Metal c) Non-metal d) Non of the above

2. In Schotty defect density of crystal is……..
   a) Increases b) Decreases
   c) Remains same d) Both increases and decreases

3. Electron and Phonon interaction produces……..
   a) Polariton b) Photon c) Polaron d) Phonon

4. In case of quantization of Elastic wave the term…….is called as Zero point energy.
   a) $2\hbar\omega$ b) $4\hbar\omega$ c) $\frac{1}{4}\hbar\omega$ d) $\frac{1}{2}\hbar\omega$

5. Dispersion relation for electromagnetic wave shows that if $\varepsilon=\infty$ then there are……..
   a) Free oscillation b) longitudinal polarized wave
   c) damped oscillations d) Transverse polarized Wave

Q2. Answer the following (any one) **(10)**

1. Explain the concept of vibrations of crystal with monoatomic lattice also explain brillouin zone, group velocity and long wavelength
2. Derive an expression for number of vacancies in Schotty defect and explain the concept of F-centre.

Q3. Answer the following (Any one) **(5)**

1. Write a note on Edge dislocation and Grain boundary.
2. Explain the concept of Quantization of elastic wave.

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Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College (Autonomous) Kolhapur

Department of PhysicsM.Sc. II

2018-19

Attendance Sheet

Paper: Solid State Physics-III

Date:09/02/2019

Roll. No.	Name of Candidate	Sign
1	Aswale Nikhil Mohan	
2	Bachate Prajakta Ramchandra	
3	Deshmukh Namita Prataproa	
4	Ghadage Sachin Subhash	
5	Jadhav Anmol Narendra	
6	Jangid Saroj Nemichand	
7	Kamble Karan Mukund	
8	Khan Anjum Ibrahim	
9	Mane Rajalaxmi Sanjayrao	
10	Mulla Shahanwaj Barkatali	
11	Nalawade Priyanka Mansing	
12	Patnkar Shivrsaj Mansing	
13	Pathak Onkar Herambraj	
14	Patil Nirmala Vilas	
15	Patil Rasika Chandrakant	
16	Pawar Pooja Gunvant	
17	Phadatare Pooja Sunil	
18	Salunkhe Abhishek Chandrashekhar	
19	Shirage Pravin Ramchandra	
20	Sid Shraddha Arun	

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27045

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. :

Roll No. : 1358

Class :

18/20

Subject : SSP - III

Test / Tutorial No. :

Div. :

Q I

1) Low

2) ~~Frenkel~~ Substitutional.

3) $F = U - TS$

4) Screw dislocation.

5) Surface. (5)

Q II

1) Schottkey defect.

Let us assume a perfect crystal in which no of +ve and -ve ions are same. ~~The~~ At low temp and equilibrium at temp $T = 0°K$ helmholtz free energy is given as

$$F = U - TS \quad \text{——— (1)}$$

Where,

U = Internal energy

S = Entropy.

2. The amount of energy required to bring an ion from interstial site to surface of crystal is given by,

$$U = n E_p \qquad \text{——— (2)}$$

Where,

n = no of vaccancies.

The Entropy S is given by,

$$S = k \log W \qquad \text{——— (3)}$$

Where,

k = Boltzmann constant

W = No of ways the in which the energy is distributed.

Assume total no of crystals as 'N' and let 'n' be no of schottkey defects, Then the value of W is given by,

$$W = \frac{N!}{n!(N-n)!}$$

But as in schottkey defect a pair of cation and anion is missing so we need to square value of W.

$$\therefore W = \left(\frac{N!}{n!(N-n)!}\right)^2 \qquad \text{——— (4)}$$

Substituting value of W in eq (3)

$$S = k \log \left(\frac{N!}{n!(N-n)!}\right)^2 \qquad \text{——— (5)}$$

Substituting eq (2) and (5) in eq (1)

$$F = U - TS$$

$$F = nE_p - T\left[k \log \left(\frac{N!}{n!(N-n)!}\right)^2\right]$$

$$= nE_p - 2KT\left[\log\left(\frac{N!}{n!(N-n)!}\right)\right]$$

$$= nE_p - 2KT\,(\log N! - \log n! \cdot \log (N-n)!)$$

$$= nE_p - 2KT\,(\log N! - \log n! - \log (N-n)!)$$

As per sterlings formula,

$$\log x! = x \log x - x$$

$$\therefore F = nE_p - 2KT\,[N \log N - N - (n \log n - n) - \{(N-n)\log (N-n) - (N-n)\}]$$

$$= nE_p - 2KT\,[N \log N - N - n\log n + n - (N-n)\log(N-n) + (N-n)]$$

$$= nE_p - 2KT\,[N \log N - n\log n - (N-n)\log (N-n)]$$

diff above w.r.t 'n'

$$\frac{dF}{dn} = E_p - 2KT\,[0 - 1 - \log n + 1 \cdot \log (N-n)]$$

$$\frac{dF}{dn} = E_p - 2KT\left[\log\left(\frac{N-n}{n}\right)\right.$$

At equilibrium temp $\frac{dF}{dn} = 0$.

$$\therefore 0 = E_p - 2KT \log\left(\frac{N-n}{n}\right)$$

Also as $N >> n$; $N - n = N$

$$\therefore 0 = E_p - 2KT \log \frac{N}{n}$$

$$\frac{E_p}{2KT} = \log \frac{N}{n}$$

$$e^{E_p/2KT} = \frac{N}{n}$$

$$\frac{e^{E_p/2KT}}{N} = \frac{1}{n}$$

$$n = N \cdot e^{-E_p/2KT}$$

For metals $E_p \approx 1eV$. When $T = 1000°K$

$$\frac{n}{N} = 2.86 \times 10^{-18} / cc.$$

As temperature increases concentration increases

In schottky defect density is reduced

Schottky defect is mostly found in alkyl halides.

Q III

⇒ 1) Point defects.

a) Points defects are the defects which are caused around a single atom or at single lattice site.

b) The defect caused does not grow with respect to time and space thatgs Why it is also called as zero dimension defect.

c) Point defect can be occurs due to:

i) Imperfect packing of crystals

ii) Deviation from regularity is confined to small region above few lattice constant.

d) There are 4 types of point defects:

i) Interstial defect

ii) Substitutional defect

iii) Schottky defect

iv) Frenkel defect.

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- शिक्षणमहर्षी डॉ. बापूजी साळुंखे

27575

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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

Suppliment No. :

Roll No. : 1358

Class :

Subject : SSP - III.

Test / Tutorial No. :

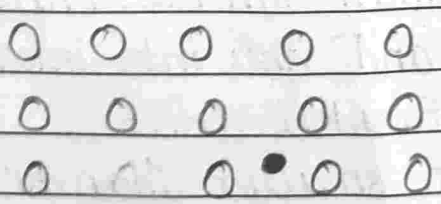
Div. :

a) Interstitial defect

i) In this defect the size of anion and cation is same

ii) The vacancy caused by when same type of atom displaces the ions into interstial site of crystal. Such defect is called as interstitial defect.

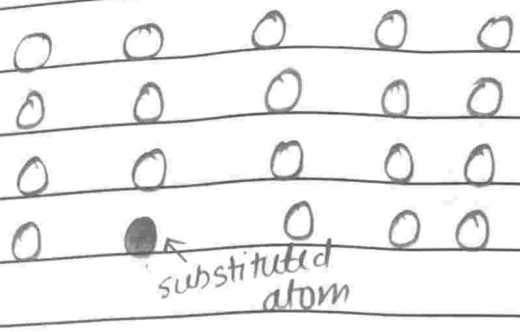
iii) They are caused due bombardment of elementary particles above threshold energy of crystal.



b) Substitutional defect.

i) It is a defect wherein a foriegn atom ~~of~~ ~~which~~ or comes into the lattice site and substitutes the orignal atom.

ii) The size of foriegn atom can be small or big as compared to orignal atom.



c) Schottkey defect.

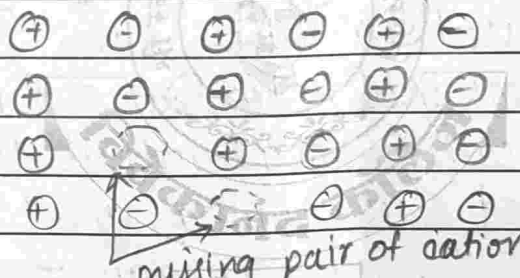
i✗ The defect wherein a pair of anion and cation is missing is called schottkey defect.

ii✗ Here the size of cations and anions are the same

iii✗ Density of crystal decreases as pair of ions are missing.

iv✗ As temperature increases equilibrium conc also increases

v✗ Mainly found in alkyl halides



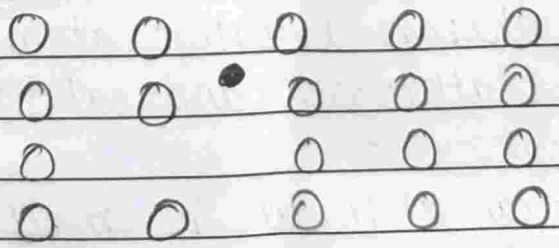
d) Frenkel defect.

i✗ The defect wherein small ion (generally cation) leaves the lattice site and goes into interstial site. Such defect is called Frenkel defect

ii✗ Here size of cation is smaller than ~~of~~ anion.

iii✗ Density mass volume does not change.

iv✗ Mainly found in silver halides.



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Signature of Supervisor

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Class : M.Sc. - II

18/20

Subject : SSP - III

Test / Tutorial No. : Internal exam

Div. : -

1] → d] Low

2] → ~~d] Interstitial~~ B] Frenkel

3] → c] $F = U - TS$

4] → B] Screw dislocation.

5] → c] surface.

4

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1] → c] Low

~~2] → c] Interstitial~~ B] Frenkel

~~3] → c]~~ F = U - TS

~~4] → B]~~ Screw dislocation.

~~5] → c]~~ surface.

4

1) Expression for no. of vaccancies in Shottky defect.

- Let us consider a 'perfect crystal at temp. 'T' having equal no. of +ve positively and negative charge particle.
- According to thermodynamics at at equilibrium concentration & at low pressure temperature T the change in energy is given Hemlhoultz free energy,

$$F = U - TS \quad \text{---} \quad (1)$$

where

U = internal energy
T - Temperature
S = Entropy.

- Let Ep is the energy of vaccancy pair to take molecule from internal side of ~~easy~~ crystal to surface of crystal.
- n is no. of vaccancy pair.
- therfore ~~Energy~~ ~~is~~ a Energy is given by E

$$U = nEp \quad \text{---} \quad (2)$$

- ~~Energy~~ Entropy is given by Boltzmann statistical relation

$$S = k \log W. \quad \text{---} \quad (3)$$

where

k = Boltzmann constant
W = no. of different ways which distributed over vibrational lattice

- Suppose N is no. of total particle atoms

- Suppose According to Shott Schottky defect pair of cation and anion missing from the lattic site.
- Therefore the probability that no. of ways in which each ion can take from lattice site.

$$W = \frac{N!}{(N-n)!n!}$$

- Here missing n of cation and anion pair so squaring the above eqn.

$$W = \left[\frac{N!}{(N-n)!n!}\right]^2 \quad \text{---(4)}$$

So eqn (3) becomes.

$$S = k \log \left[\frac{N!}{(N-n)!n!}\right]^2 \quad \text{---(5)}$$

Therefore put eqn (2) & (5) in eqn (1) we get

$$F = nEp - T\left\{k \log \left[\frac{N!}{(N-n)!n!}\right]^2\right\}$$

$$F = nEp - 2KT\left\{\log\left\{\frac{N!}{(N-n)!n!}\right\}\right\}$$

$$F = nEp - 2KT\left\{\log N! - [\log(N-n)! - \log n!]\right\}$$

Above term expanding by sterling formula

is given by $\log x! = x \log x - x$

$$F = nE_p - 2KT\left[N\log N - N - \left\{(N-n)\log(N-n) - (N-n)\right\} - n\log n + n\right]$$

$$F = nE_p - 2KT\left\{N\log N - N + (N-n)\log(N-n) - (N-n) - n\log n + n\right\}$$

$$F = nE_p - 2KT\left\{N\log N + (N-n)\log(N-n) - n\log n\right\}$$

differentiating w.r.t n we get.

$$\frac{dF}{dn} = E_p - 2KT\left[0 + \log(N-n)\cdot\frac{1}{(N-n)} + \log(N-n)\cdot 1 - \left(K\cdot\frac{1}{K} + \log n\cdot 1\right)\right]$$

$$\frac{dF}{dn} = E_p - 2KT\left[0 + 1 + \log(N-n) - 1 - \log n\right]$$

$$\frac{dF}{dn} = E_p - 2KT\left[\log\frac{(N-n)}{n}\right] \quad -(6)$$

Here $\frac{dF}{dn} = 0$.

Therefore eqn (6) becomes

$$0 = E_p - 2KT\left[\log\frac{(N-n)}{n}\right]$$

$$E_p = 2KT\left[\log\frac{(N-n)}{n}\right]$$

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$$\cdot \frac{Ep}{2kT} = \log \frac{N-n}{n}$$

$$e^{-Ep/2kT} =$$

$$\frac{e}{Ep/2kT} = \frac{N-n}{n}$$

$$\cdot e^{-Ep/2kT} = \frac{n}{(N-n)}$$

$$(N-n) \cdot e^{-Ep/2kT} = n.$$

(g) $$n = (N-n) \cdot e^{-Ep/2kT}.$$

- For metal Ep = 1 eV at temp $T = 1000K$ and $\frac{N}{n} = 2.86 \times 10^{-18}/cc$
- Schottky defect decreases the density of crystal
- In this defect as concenhation decrease also Temp decreases.

1] Point Point defect & it's type.

Crystal defect control and affect the behavior of material. Electrical and thermal conductivity decreases due to point defect. Defect's in crystal plays important role in behavior of material.

Point Defect -

The defect which occurs around the atom or particle which is called as point defect.

- Point defect occurs only at one atom or particle.
- Point defect does not extended in space in any dimension so it is called as zero dimentional defect.
- Point defect is the smallest possible defect in crystal.
- Their are four type of point defect as given below.
  1. Interstitial defect.
  2. Substitutional defect
  3. Schottky defect
  4. Frenkel defect.

1. Interstitial defect :
   - A point defect in which an atom goes in interstitial position of lattice site.
   - The atom will be same atom of lattice or foreign atom.

- Such defect shows like in Hydrogen and Palladium.
- In Interstitial defect the ~~at~~ atom causes defect which are smaller than host atom.

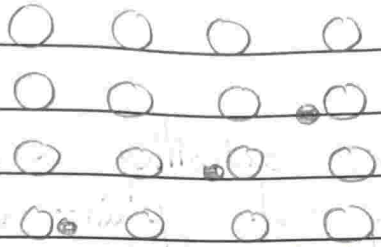

Fig a - Interstitial defect

② ~~St~~ Substitution defect.

- A point defect in which foreign atom replaced ~~the~~ on position of original lattice atom.
- In this defect The foreign atom is equal size in original atom.
- Unlike a Interstitial defect the atom takes a interstitial position ~~do~~ ~~not~~ but replaced a ~~forgi~~ foreign particle ~~by~~ the in original host atom.

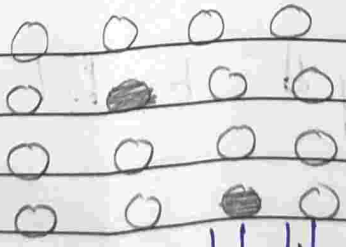

Fig b - substitutional defect

③ Schottky defect.

- It is the type of vacancy defect.
- In this stiochometric defect cation and missing from their lattice site in equal no.

- Schottky defect decrease the density of crystal
- eg. NaCl. KCl

fig. Schottky defect.

- The missing of pair of anion and cation which neutralizes the charges.

④ Frenkel defect.

- Here the cations are smaller than anion.
- The defect in which vaccancy is generated by cation replaced their position with interstitial position is called as Frenkel defect.

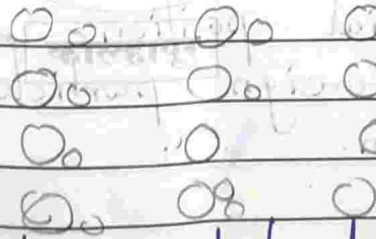

fig ④ - Frenkel defect

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Vivekanand College, Kolhapur (Autonomous)

Department of Physics

M.Sc. Part-II SEM IV Internal Examination (2018-19)

SSP IV (Energy Conversion and Storage Devices)

Time - 12:00 - 01:00 pm

Total Marks: 20

Instructions:-

1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of log table and calculator is allowed.

Q1. Fill in the Blanks (1 mark for each) **(5)**

1. The region where the electrons and holes diffused across the junction is called _____
A) Depletion space B) Forward bias C) Depletion region

2. Dark current is the ..... That flows in the Solar cells is due to the absence of light.
A) Current at night B) leakage current C) light generated current

3. Solar cell generates I-V curve in ..... Quadrant.
A) I B) IV C) III

4. The series resistance in solar cell is a .....between the metal contact and the silicon.
A) Insulator B) contact resistance C) charge generators

5. The amount of photo generated current increases slightly with increases in.....
A) Resistance B) Temperature C) Low power

Q2. Answer the following (Any one) **(5)**

1. Discuss p-n junction Solar cells under dark and illumination state.
2. Derive I-V equation for solar cells
3. How solar simulator works?

Q3. Answer the following (Any one) **(10)**

1. Explain the Design of solar cell for High Voc, Fill factor and efficiency.
2. What are Second generation solar cells? Explain in details with Examples.
3. Define Solar cell. Explain the effect of various parameters on solar cells.

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Department of PhysicsM.Sc. II
2018-19
Attendance Sheet
Paper: Solid State Physics-IV
Date:09/02/2019

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Signature of Supervisor	

Name- Aishwarya Suryakant Gaikwad

Suppliment No. : 1

Roll No. : 1334.

Class : M.Sc II.

Subject : Solid State physic- IV

Test / Tutorial No. : 2.

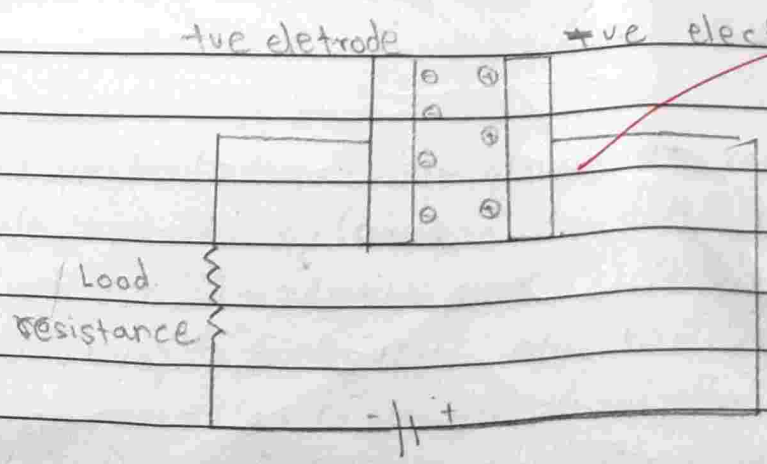
Div. : -.

15/20

Que-2) Explain EDLC type capacitors. Explain various models and structure of EDLD types capacitors.

Ans:

1) EDLC stands for electric double layer capacitor.
2) In this type of capacitor two electrode are present we placed insulating layer in between two electrode.
3) After placing insulating layer we apply charge on each electrode. that charge is opposite to electrode.
4) We apply +ve charge of negative electrode and -ve char on positive electrode.
5) Afterward its work like a electric double layer capaci



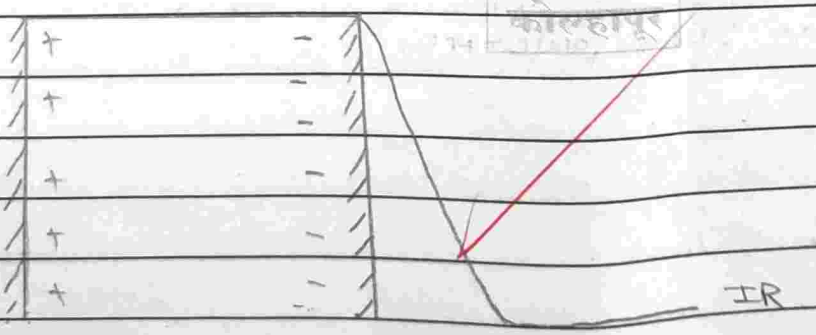
Schemetic digram of electric double layer capacitor

6) For eg- Carbon electrode.

- Various types of electric double layer capacitor, are as. Follow- direct capacitor and pseudo capacitor

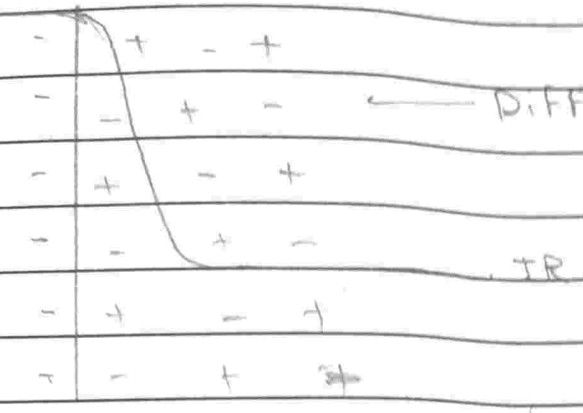
7) In this capacitor electric charge is balanced.

- Holtmez's doble layar capacitor →



- In this type of capacitor two layers are seperated by a distance with ionization of electrode. it seperated charge electrode.
- It is discovered by Van Holtmez's thats whay double layer capacitor gets modified into Holtmez's capacitor.
- It help to seperate electrode in no. of cells
- Balance charge is ~~de~~ equilibrium of that no. of cells.

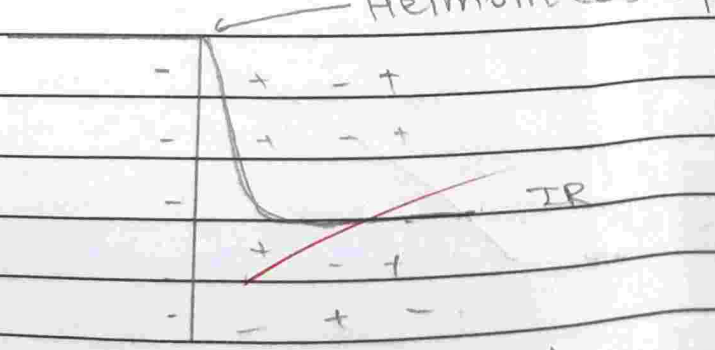
2) Gaug's Model :→



Gaug's Model.

* It inserted between profile and local film near electrode surface.
- The capacity of charge can be deduce by using this model.
- Near film of capacitance can be found near the electrode.
- The positive and negative charge interacted on both side of electrode.
- Interacting of both side of detected on gabg's model.

3) Stern's model :



Stern Model.

- The capacitance of finite atoms are defined on the geomatic limit of ionization of particle.
- The eq^n of model -

$$\frac{1}{C_{dl}} = \frac{1}{C_H} + \frac{1}{C_{dif}}$$

Que 3). Charge and discharge curve of battery and capacitor.

A 1) Charge and discharge curve is formed in From of cyclic voltametric.

2) It is ratio of voltange with time which is as Follow -

$$\frac{dv}{dt} = s.$$

The charge and discharge produce current that is '$\pm I$'.

3) In cyclic voltage direction of positive ane negative charge is in mirror image from of sweep.

4) It sweep is show different characteristics for study of charge curve we examine curve of Rubiu (RuO_2)

5) For discharge we will examine $Pb-PbCl_2$ model and its curve.

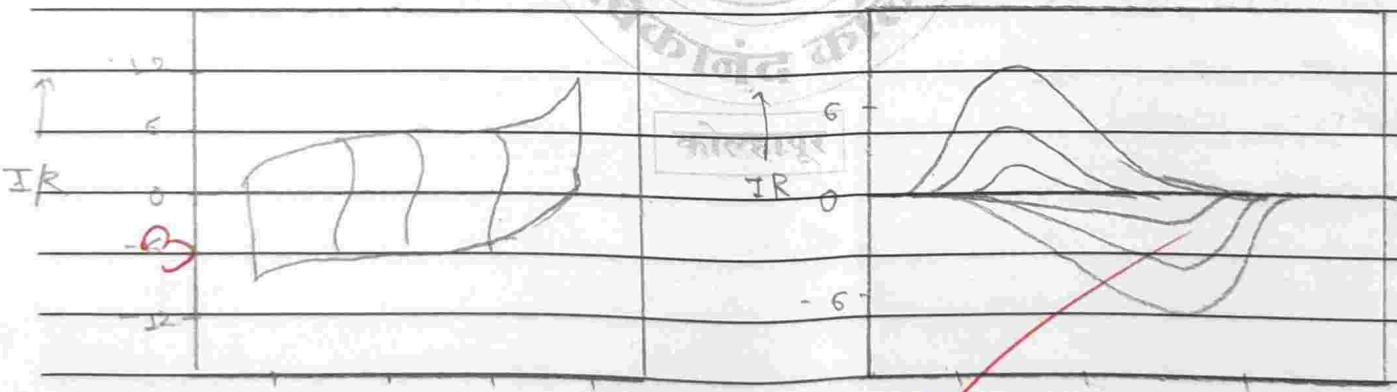


Fig (a) Curve of RuO_2

Fig (b) Curve of $Pb-PbCl_2$

6) RuO_2 shows a condition of mirror image

7) Reverse process helps in charging and discharging of ~~electrode~~ oxidation.

8) The charge of positive and negative in RuO_2 and ~~Pb-PbCl₂~~ is balanced by oxidation

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Subject :
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Div. :

9) In oxidation 0.4 of electrode consist of positive charge on electrode sweep.

10) both ~~ch~~ of oxidation in RuO_2 shows mirror image.

Que. 1)

4) ~~Mirror~~ Asymmetric.
2). electrostatic force.
3). δ MnO_2.
4) ~~MnO_2~~. Pseudo capacitor.
5) Semiconductor.

Que. 1)

1) Asymmetric.
2) Electrostatic force.
3) MnO_2.
4) Pseudo capacitor.
5) Semicounde.

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Department of Physics

M.Sc. Part-II SEM IV Internal Examination (2018-19)

Electronic devices

Time - 12:00 - 01:00 pm Total Marks: 20

Instructions:-

1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of log table and calculator is allowed.

Q.1. Choose correct alternative **(5)**

i) In case of n-p-n transistor, base transport factor (α_T) is .....

a) measure of the injected hole current compared with the total emitter current
b) ratio of the hole current reaching the collector to the hole current injected from the emitter
c) leakage current between the collector and the base with the emitter base junction open
d) common base current gain

ii) The collector current for the common-base configuration in p-n-p transistor is given by

a) $I_C = \alpha_0 I_E + I_{CBO}$ b) $I_C = \alpha_0 I_B + I_{CEO}$ c) $I_C = \gamma + I_{CEO}$ d) $I_C = \alpha_0 I_B + \gamma$

iii) To derive the current-voltage expression for an ideal transistor, which of the following condition is wrong ?

a) The device has uniform doping in each region
b) The hole drift current in the base region as well as the collector saturation current is negligible
c) There is high-level injection
d) There are no series resistances in the device

iv) In p-n-p transistor , to improve the frequency response, the transit time of minority carriers across the base must be....., therefore, high-frequency transistors are designed with a ..... base width.

a) Short, short b) High, high c)Short, high d)High, short

v) MESFET stands for .....

a) metal-semiconductor field-effect transistor
b) metal electron semiconductor field-effect transistor
c) metal elemental semiconductor field-effect transistor
d) metal based electrical semiconductor field-effect transistor

Q2.Attempt any one **(5)**

i) Explain modes of operation of BJT depending of polarities of EB and CB junction
ii) Write a note on frequency response of BJT and hence obtain equation for transit time of minorities carriers

Q3.Attempt any one **(10)**

i) Write a note on construction and working of BJT. Hence obtain the relation of collector current for n-p-n transistor
ii) Elucidate MESFET device structure and its application

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Department of PhysicsM.Sc. II

2018-19

Attendance Sheet

Paper: Electronic Devices and Application

Date:08/02/2019

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Ghadage Sachin Subhash

Suppliment No. :

Roll No. :

Class :

Signature of Supervisor

Subject : Electronic Devices & Applications

Test / Tutorial No. : Internal Exam 2019.

Div. : —

Q.2) choose Correct alternatives.

Answer

i) a) measure of the injected hole current compared with the total emitter current.

ii) c) $I_C = \alpha I_E + I_{CBO}$

iii) a) The device has Uniform doping in each region

iv) d) High, short

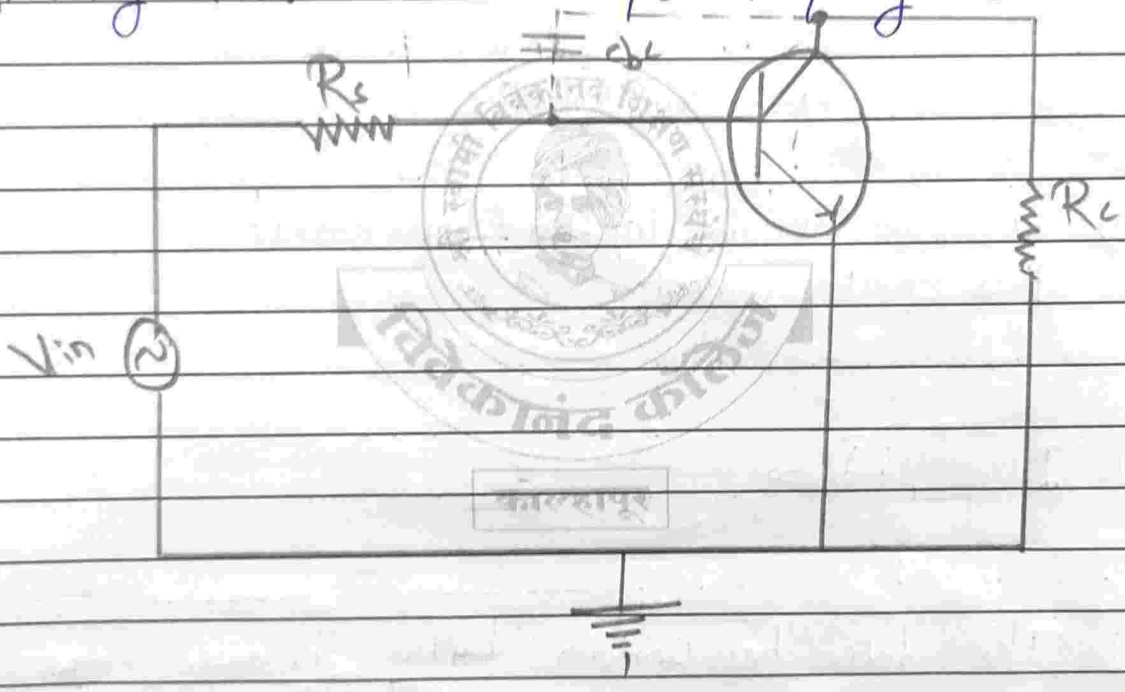
v) a) metal semiconductor field effect transistor.

Q.2) Frequency Response of BJT

a) High frequency response
b) Low frequency response.

a) High Frequency Response

At high frequencies, internal transistor junction capacities become into play, reducing an amplifier gain & introducing phase shift as signal frequency increases



Current in $i_{in} = \frac{V_{in} - (-AV_{in})}{X_c}$

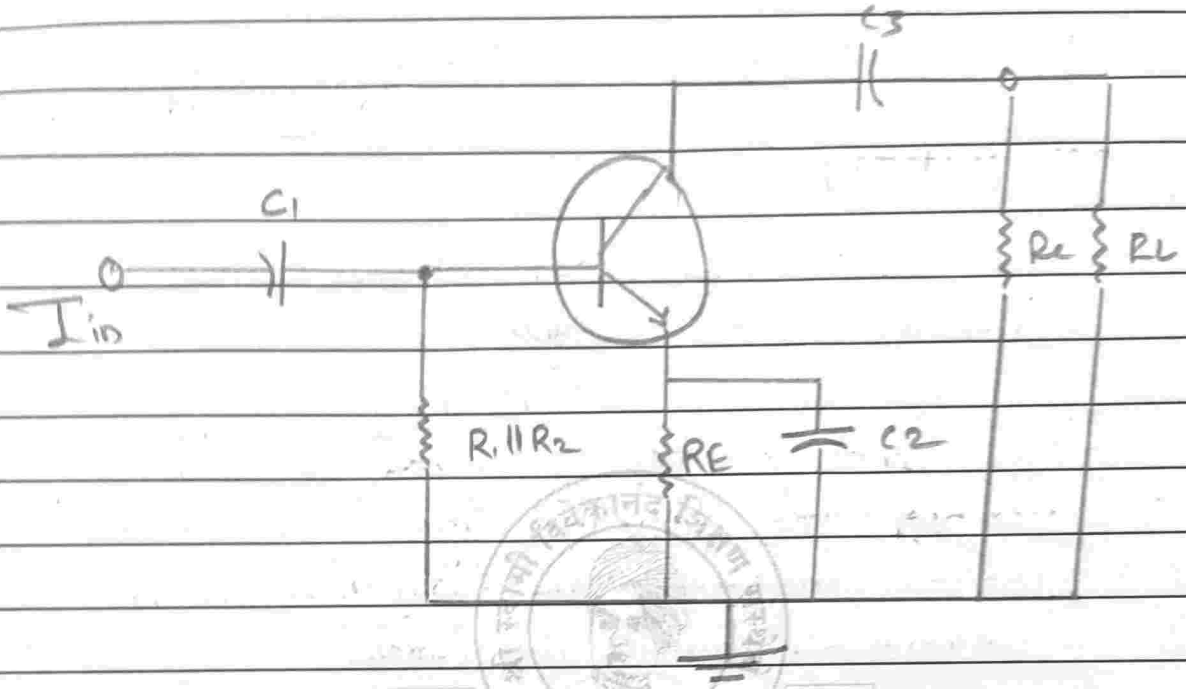
$$Z_{in} = \frac{V_{in}}{I_{in}} = \frac{1}{2\pi \times f \times C_{in}}$$

$$\therefore C_{in} = (1+A) \times C_F$$

$$X_c = \frac{1}{2\pi \times f_c \times C_{total}}$$

$$\therefore f_c = \frac{1}{2\pi \times (R_s \| R_1 \| R_2 \| R_{in(base)}) \times C_{total}}$$

b) Low Frequency Response: Input RC circuit.



The dB voltage is given by,

$$V_B = \left(\frac{R_{in}}{\sqrt{X_{C_1}^2 + R_{in}^2}} \right) V_{in}$$

Now the lower critical frequency is written as,

$$X_{C_1} = \frac{1}{2\pi \times f_c \times C_1} = R_{in}$$

$$\therefore f_c = \frac{1}{2\pi \times (R_s + R_{in}) \times C_1}$$

Lowers signal internal resistance

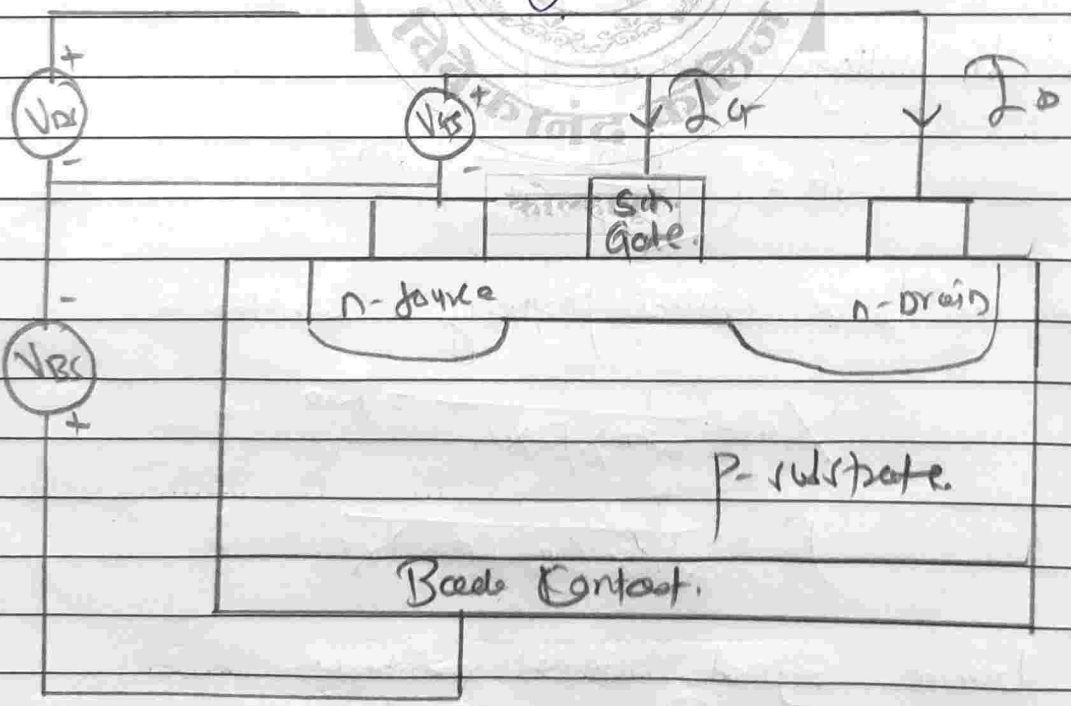
$$R_{in} = R_1 \| R_2 \| R_{in\text{-}base}$$

$$\therefore X_c = \frac{1}{2\pi f \times C_3} = R_c + R_L$$

$$f_c = \frac{1}{2\pi \times (R_c + R_L) \times C_3}$$

• MESFET •

- It is also called Metal Semiconductor Field Effect.
- It is also known by Schottky gate FET.
- It consists of a conducting channel positioned between a source & drain contact region.
- The carrier flow from source to drain is controlled by a schottky metal gate.
- The control of the channel is obtained by varying the depletion layer width underneath which modulates the thickness of the conducting channel & thereby the current.



॥ ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ॥
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे
07002
Shri Swami Vivekanand Shikshan Sanstha Kolhapur's
VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Kamble Karan mukund.

Suppliment No. :

Roll No. :

Class :

Signature of Supervisor

Subject : E-D Applications

Test / Tutorial No. : Internal Exam- 2018-19

Div. :

(Q.1) · Correct Alternatives.

1) → (a)

2) → (c)

3) → (a)

4) → (d)

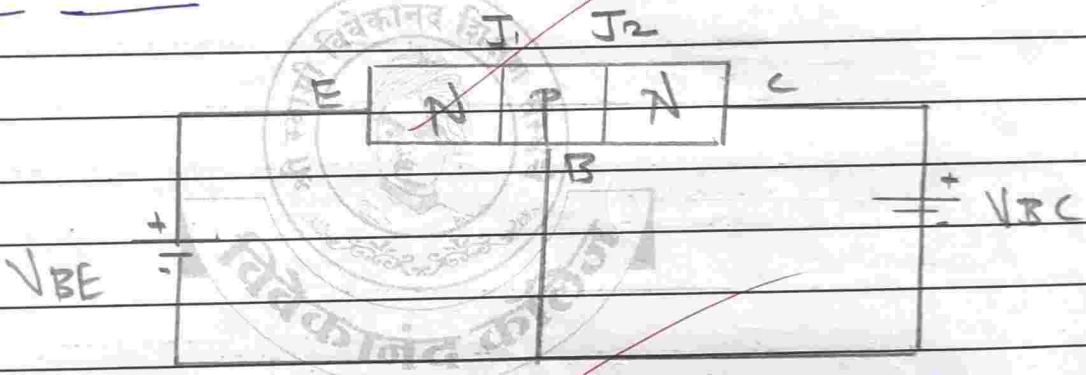
5) → (a)

05

Q.2) Operation of BJT : Polarities of EB & CB junctions.

- It has three modes of operation
  - Cut-off mode
  - Saturation mode
  - Active mode
- We have to apply dc voltage to transistor biasing if must.

a) Cutoff mode :



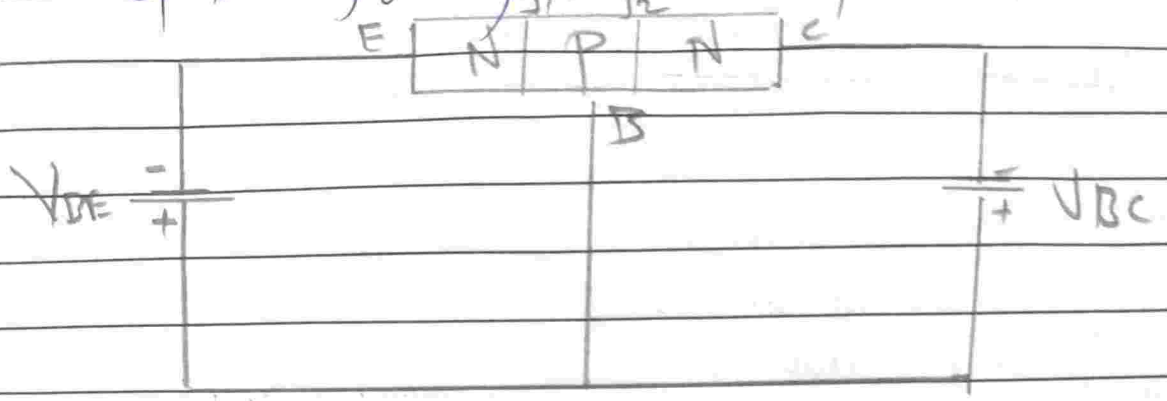
Cutoff mode

- both junctions are reverse biased.
- In reverse bias condition no current flows through the device.
- Transistor is in off state & act like an open.

b) Saturation mode :

- Both junctions are forward biased.
- In forward bias condition, current flow through the device.

· Electrons flow from emitter to collector.



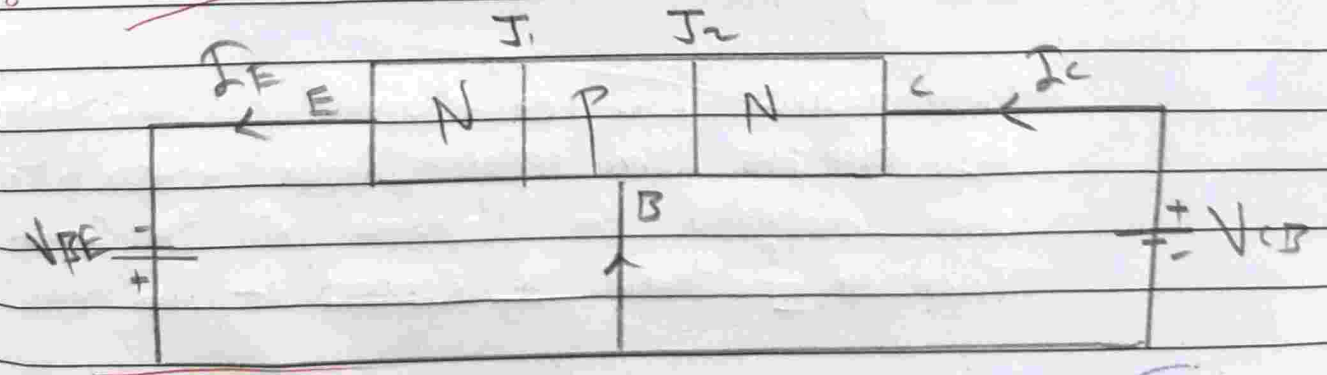
· In on state it acts like a closed switch.
· We can use transistor as an ON/OFF switch.

c) Active Mode:

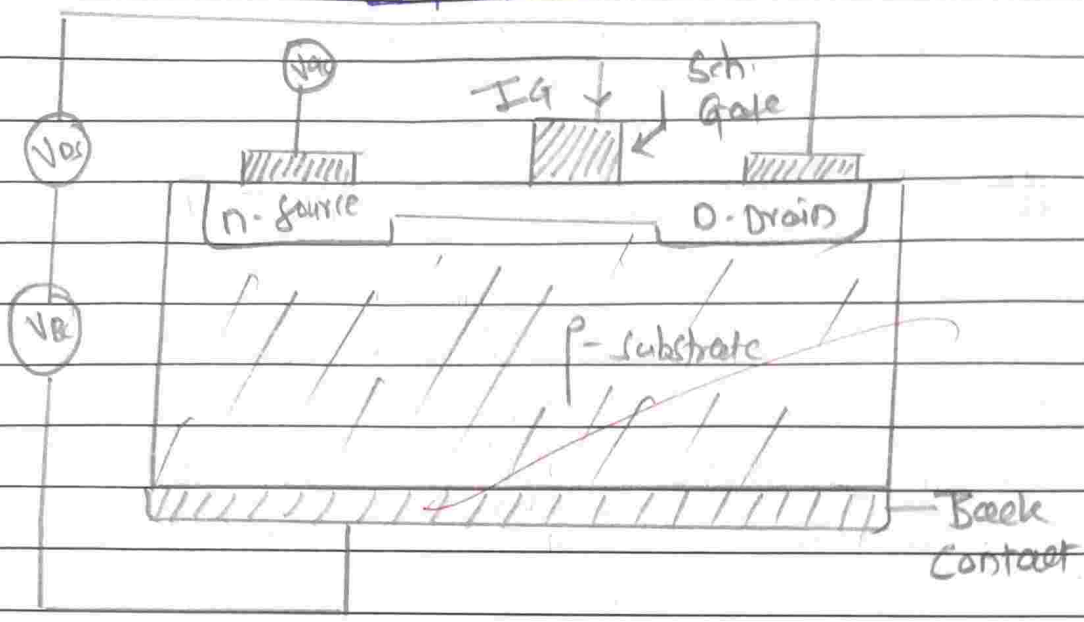
· One junction in forward biased & other in reverse biased.

· The active mode of operation is used for the amplification of current.

08



• MESFET •



- Called as metal Semi-Conductor Field effect.
- It is also known as Schottkey gate FET.
- It consists of a conducting channel positioned between a source & drain contact region

OS

- The carrier flow from source to drain is controlled by a schottkey metal gate.
- The control of the channel is obtained by varying the depletion layer width underneath which modulates the thickness of the conducting channel & thereby the current.