Notice

Date: Monday, 14/11/2022

It is hereby informed to the students of M.Sc. – I and II, that First Term Internal Evaluation Examination is scheduled between 28th to 29th November 2022 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 afterwords in any case.

Sr. No.	Date	Class	Name of the Paper	Time
01	28/11/2022	M. Sc. – I	(01) Mathematical Physics	12 – 01 PM
			(02) Classical Mechanics	02 – 03 PM
02	28/11/2022	M. Sc. – II	(01) Nuclear and Particle Physics	12 – 01 PM
			(02) Thin Film Deposition and other Techniques	02 – 03 PM
03	29/11/2022	M. Sc. – I	(01) Quantum Mechanics I	12 – 01 PM
			(02) Condensed matter Physics	02 – 03 PM
04	29/11/202	M. Sc. – II	(01) Solid State Physics – 01	12 – 01 PM
			(02) Solid State Physics – 02	02 – 03 PM

Coordinator

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

VIVEKANAND COLLEGE ESTD JUNE 1964 KOLHAPUR - 416003

Seat No.

Vivekanand College , Kolhapur (Autonomous).

M. Sc. Part-II (Semester- III) Internal Examination Oct/Nov.2022

Subject: Physics

Title: Nuclear and Particle Physics

Total Marks: 20

Time: 12.00 – 1.00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Figures to the right indicate full marks.
4) Use of Scientific calculator or Log table is allowed.

Q. 1 Select most correct alternative **(05)**

i) Cosmic rays are produced in .....

a) near moon b) near sun c) in volcanoes d) in outer space

ii)Cyclotron is used to accelerates .....

a)Protons b)electrons c)neutrons d)both (a) and (b)

iii)G. M. counter is based on principle of .....

a)transformer b)scintillation c)ionization d)gravitational

iv)Wilson cloud chamber is generally useful for detecting .....

a)cosmic rays b)X-rays c)cathode rays d)laser rays

v) Protons and neutrons together called as .....

a)Nucleons b)hyperons c)baryons d)epsilons

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

i) Elucidate in brief "Cosmic Rays".

ii) What is matter & antimatter? Explain with special reference to positron and antiproton.

Q.3) Attempt any One **(5)**

i) Write a note on cosmic rays showers.

ii) Define i) Primary cosmic rays
ii) Secondary cosmic rays
iii) Soft component of cosmic rays
iv) Hard component of cosmic rays

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Vivekanand College (Autonomous) Kolhapur

Department of PhysicsM.Sc. II

2022-23

Attendance Sheet

Paper: Nuclear and particle physics

Date:28/11/2022

Roll. No.	Name Of Candidate	Sign
1	Kshirsagar Vijaya Suresh	
2	Kumbhar Pooja Prakash	
3	Kurade Shubhangi Shivaji	
4	Latthe Sammed Rajendra	
5	Nikam Mrunali Tanaji	
6	Patil Aakansha Bhimarao	
7	Patil Anuja Dattajirao	
8	Patil Rajat Jaywant	
9	Patil Sanyogita Sanjay	
10	Patil Shrutika Jaysing	
11	Pirale Siddhant Deepak	
12	Rajguru Supriya Dhanaji	
13	Rajput Prerana Pundlik	
14	Sakate Santosh Shripati	
15	Sayyad Alsaba Javed	
16	Shelar Avinash Sanjay	
17	Sonkamble Rohan Raju	
21	Sutar Pooja Vishwanath	
22	Gaikwad Aishwarya Suryakant	
23	Chougule Shraddha S.	
24	Gaikwad Divya Ramesh	
26	Gavade Sayali Shantaram	
27	Gurav Rutuja Ravindra	
28	Hirave Pravin Prakash	
29	Jadhav Nikhil Sandeep	
30	Jamadar Wahida Sardar	
31	Kukade Seema Vishnu	
32	Khandekar Pooja Sanjay	
33	Khokar Raeez Rafiq	
34	Khot Priyanka Balaso	
35	Kondare Adinath Bhaskar	
36	Kore Jyoti Vinayak	

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Name- Aishwarya Suryakant Gaikwad.

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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 11/20

Roll No. : 1334

Class : M.Sc II

Subject : Nuclear

Test / Tutorial No. : Internal No-1.

Div. : -

Que.1)

1) ~~Soft~~

2) ~~Maximum~~

3) ~~Greater than~~

4) ~~1~~

5) ~~Pions.~~

2

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Que:3)

Cosmic Rays →

Cosmic Rays are rays encourge in earths atmosphere from space. They does empact on earths surface. There are two types of cosmic rays. they are

1) Primary cosmic rays.
2) Secondary cosmic rays.

1) Primary cosmic rays →

The rays which enter earths atmosphere direct from sun, thus called primary cosmic rays. they are produce due to continus erruption on suns surface. thus erruption emittes hight amount of energy. that energy enters earths atmospher in from of rays. primary rays are unever they are from of energy.

2) Secondary cosmic rays →

Secondary cosmic rays are also enter in earth's atmosphere from space. but they are even and regular the erruption on Sun's surface from rays but they are not regular or even so thus rays are not coming from sun. In our milky way galaxy there are 10^{11} sun's or stars are present. some are double star's as well as massive starts. So recent assumption thus rays are come from inter interstellar space. cause emittion of rays from stars of our galaxy is nearly similar to sun. Thus far away rays are also known as secondary cosmic rays. the intensity of secondary cosmic rays are less than intensity of primary cosmic rays.

3

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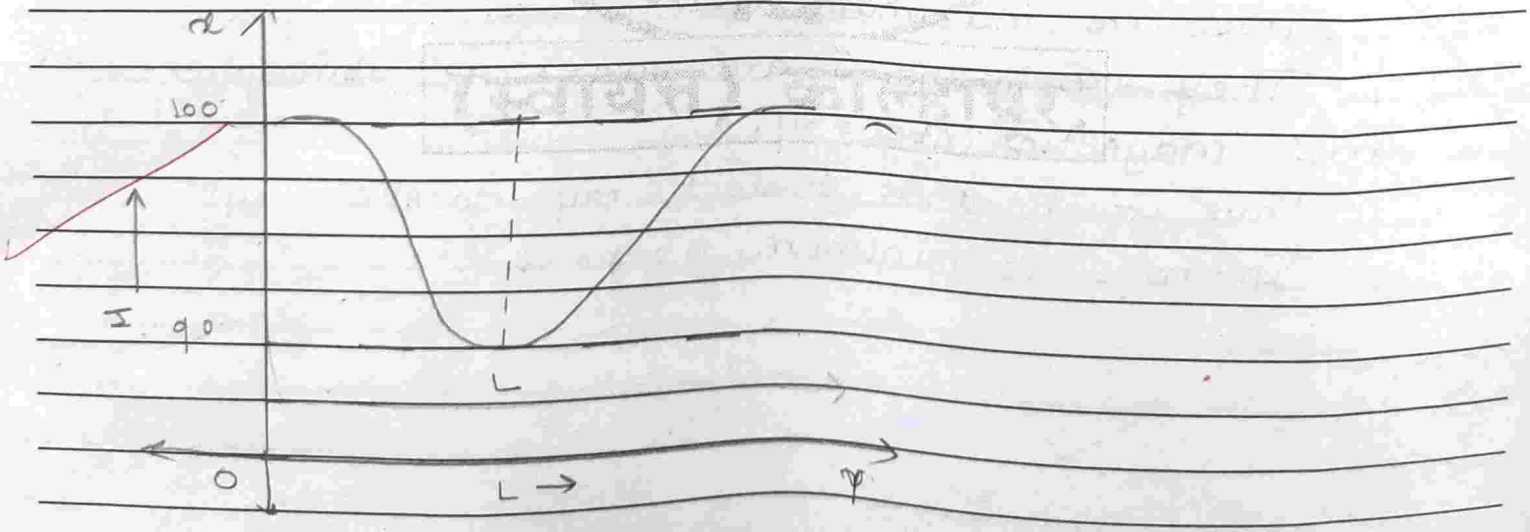
Que.8) Variation in intensity of cosmic rays.

Variation in intensity of cosmic rays is depends upo direction of rays. they are divided into three part accord to direction .. as below-

1) Lattitude - cosmic rays intensity
2) Alttitude cosmic rays intensity.
3) East-west cosmic rays or azimuth effect

1) Lattitude →

- Lattitude is rays which travel ~~no~~ along direction of poles.
- Variation of intensity is in from of geomertic intensity.
- It is continesusly in all region.
- Intensity is decrease as come from earth's equater
- The cosmic ray intensity is minimun at 10% at intensity.
- Cosmic rays can intersity variation according to earths magnetic ~~intensity~~ intensity.



2) Altitude →

- In ~~it~~ increases alternatively in atmosphere ~~but~~ it is not maximum or minimum.

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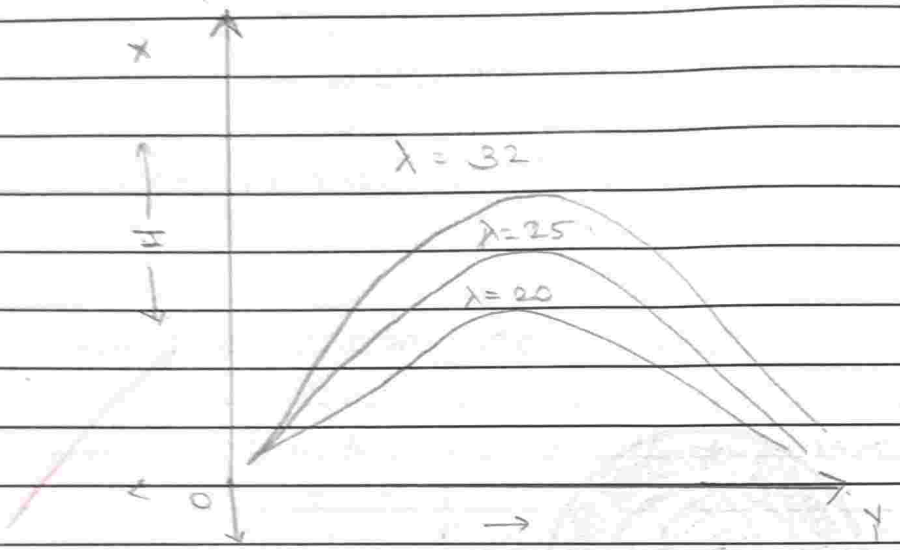
- There intensity is maximum at poles.
- Intensity is increase by high altitude as 20 K - 25 K.
- ~~Intensity~~ The primary cosmic rays and secondary cosmic rays are present in altitude.



3) East-west intensity of cosmic rays [Azimuth Effect] →.
- Thus are also present in earth's atmosphere. they Shows less intensity than other.
- Thus are less effective cosmic rays.
- Thus are maximum at equators.
- ~~They~~ are intensity are varies as atmosphere is varies magnetic intensity.
- Thus are hard to ~~deatect~~ ~~rays~~ cosmic rays.
- Intensity is minimum at poles.

6

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Shraddha Sanjay chougule

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SUPPLIMENT

8/20

Signature of Supervisor	

Suppliment No. :

Roll No. : 1332

Class : M.SC - II (Physics)

Subject : Nuclear and Partical Physics

Test / Tutorial No. :

Div. : –

Q1

(1) ~~soft~~

(2) Maximum

(3) greater

(4) ~~1~~

(5) ~~Pions~~

8/20

2

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Q2. 2. The variation in intensity of cosmic ray

1] Lattitude →

① It is a variation of cosmic ray intensity with geomagnetic intensity.

② The cosmic ray intensity is maximum at the uniform reigon.

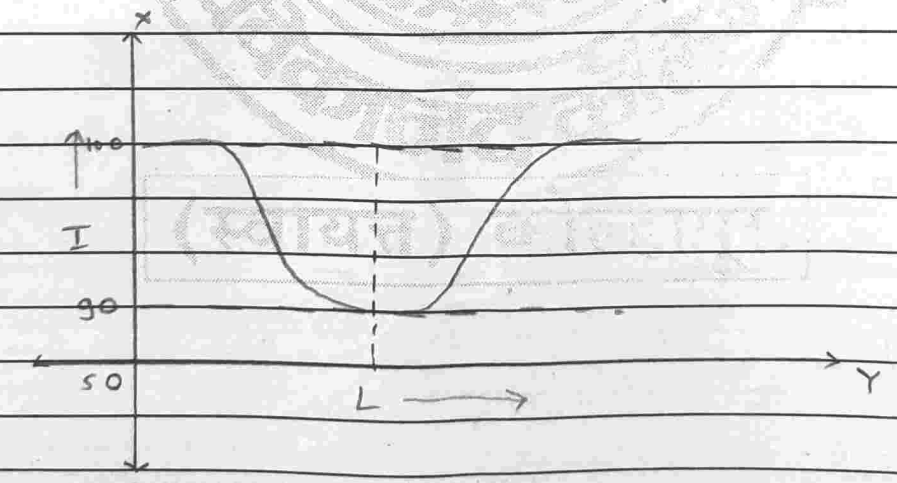
③ it is decreases continously more and more up to the equator.

④ The cosmic ray intensity is minimum at 10 % less than intensity

⑤ The cosmic ray can explian their variation of earth magnetic intensity

⑥ The lattiude is prove by the intensity of charged particles

⑦ The ray goes deep at the atmosphere then intensity is fall and adsobtion is increses



2] Alttitude →

① The intensity increases alternaltity the alttiude is also increase but ~~the~~ it not maximum at atmosphere.

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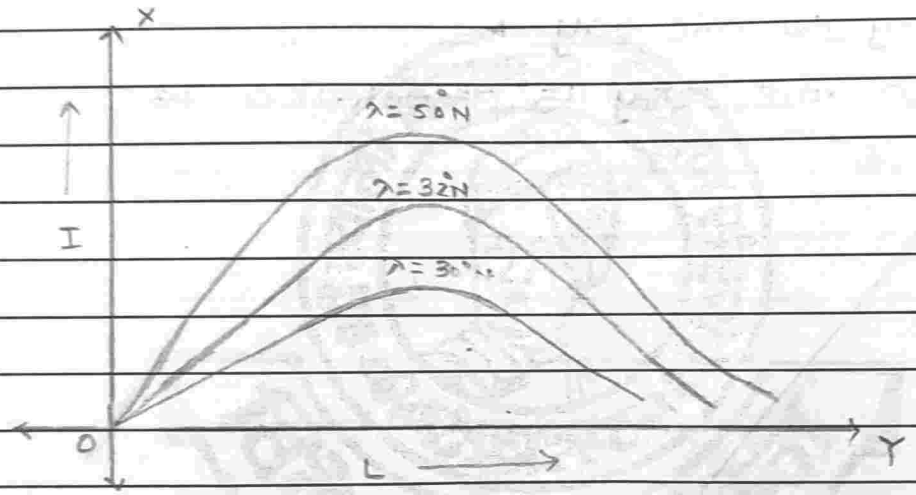
② The intensity increase with increasing altitude at the hight 20K to 25K.

③ The cosmic ray increase with intensity will increase and their geomagnatiude is increase.

④ The primary cosmic ray and secondary cosmic ray is present at this altitude.

⑤ The variation of intensity at atmospher is earth magnetitude is parllel to the cosmic rays.



3] East - weast intensity →

① The cosmic ray coming from weast is greater than east this process is known as azimuthal effect.

② azimuthal effect is maximum at the equator.

③ In this effect cosmic rays coming from the weast is 10% more than cosmic ray coming from the east.

④ The cosmic ray coming at earth's atmosphere is have various magnetic intensity.

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this intensity is ⊥er to the magnetic intensity.

⑤ I_W and I_E the intensity of weast and east cosmic ray can representive by the given eqn.

$$\frac{I_W - I_E}{I_W + I_E}$$

Q3. 1

Primary cosmic ray →

~~cosmic ray is precipted to~~

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M.Sc. Part- II (Sem-III) Internal Examination (2022-2023)

Thin film deposition techniques &

Other Properties

Time - 11:00 am - 12:00 noon Marks: 20

Instructions: 1) All the questions are compulsory.

2) Figures to the right indicate full marks.

3) Draw neat labeled diagrams wherever necessary.

4) Use of log table/calculator is allowed.

Q. 1) Select most correct alternative. **(5)**

i) The ratio of the intensity of magnetization to the magnetizing field H is called as magnetic .....

A) permeability B) susceptibility C) induction D) moment

ii) The intensity of magnetization is given by .....

A) M/A 3) m/V C) m/A D) mA

iii) Hall voltage is directly proportional to.....

A) current B) electric field C) magnetic flux D) temperature

iv) The high rate of deposition of thin film is possible with

A) magnetic sputtering B) getter sputtering

C) triode sputtering D) diode sputtering

v) In laser photolytic photochemical deposition (LPD).... of sufficient energy are used to dissociate the molecules.

A) photons B) neutrons C) hydrogen atoms D) electrons

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

i)What is mean by thin film? Give the different methods of thin film deposition by evaporation

ii) Derive an expression for diamagnetic susceptibility using quantum theory. Discuss the temperature dependence of susceptibility.

Q3. Attempt any One **(5)**

i) Explain the effect of temperature on the conductivity of metals and semiconductors.

ii) Write note on Hall effect:

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M.Sc. II

Internal Exam : Attendance sheet

Solid state physics - I

Roll No.	Marks	Name	Sign
1331			
1332	16	shraddha S. chougule	[signature]
1333			
1334	07	Aishwarya Suryakant Gaikwad	[signature]
1335	10	Divya Ramesh Gaikwad	[signature]
1336	16	Gawade Sayali Shantaram	[signature]
1337	15	Gurav Rutuja Ravindra	[signature]
1338	09	Pravin Prakash Hirave	[signature]
1339	10	Nikhil Sandeep Jadhav	[signature]
1340	10	Jamadar Wahida Sardar	[signature]
1341	16	Kakade Seema Vishnu	[signature]
1342	13	Khandekar Pooja Sanjay	[signature]
1343	08	Khokhar Raeez Rafiq	[signature]
1344	13	Khot Priyanka Balaso	[signature]
1345			
1346	02	Kondare Adinath Bhaskar	[signature]
1347	08	Kore Jyoti Vinayak	[signature]
1348	11	Kshirsagar Vijaya Suresh	[signature]
1349	15	Kumbhar Pooja Prakash	[signature]
1350	17	Kurade Shubhangi Shivaji	[signature]
~~1351~~			
~~1352~~			
1351	07	sammed Rajendra latthe	[signature]
1352	07	Nikam Mrunali Tanaji	[signature]
1353	10	Aakansha Bhimrao Patil	[signature]
1354	17	Anuja Dattajirao Patil	[signature]
1355			
1356	11	patil sanyogita sanjay	[signature]
1357	15	Patil Shrutika Jayasing	[signature]
1358	15	Pirale siddhant Deepak	[signature]

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Signature of Supervisor	

Suppliment No. :

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Class :

Subject :

Test / Tutorial No. :

Div. :

1359	16	Rajguru Supriya Dhanaji	Rajguru
1360	16	Rajput Prerana pundlik	Rajput
1361			
1362	07	Sayyad Alsaba Javed	Sayyad
1363	15	Shelar Akash sanjay	Shelar
1364			
1365	16	Pooja vishwanath sutar	Sutar

Name- Anuja Dattajirao Patil

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SUPPLIMENT

Signature of Supervisor	

Suppliment No. :

Roll No. : 1354

Class : MSC-II

Subject : SSP-I

Test / Tutorial No. :

Div. : 17/20

Q1.

1. b) $GaCl_3 + AsH_3$

2. a) Partially filled

3. b) gains.

4. b) ~~bromoethane~~ c) ~~Zirconium~~.

5. a) chemical reaction

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Q.2.

1. Methods of film preparation.

The CVD technique has different deposition methods some are explained now:-

Nakamura reported the CVD technique to apply to form amorphous boronnitrit film. The setup is consist of 2 adjustable leak walls.
The one end of wall is of ammonia NH_3 & the other is wall is of decaboran.
The deposition of film is on Ta or Si substrate.
The temperature of this technige is kept at 300'k to 1150°k
The time took for this deposition was 30 min - 300 mins.
The crystal structure of the film deposited was studied by x-ray diffraction.

A vertical cold wall low pressure CVD is used to prepare WSi_2 film.
Quartz bell jar of 24cm is used as working chamber to deposition.
graphite is coated with silico as a heat element.
WF_6 & SiH_4 are used as reactant gas agents
temperature of this is kept at 400°k
And the camber pressure is maintained at 10 Torr.
Heat flow is controlled by electric controll furnance.

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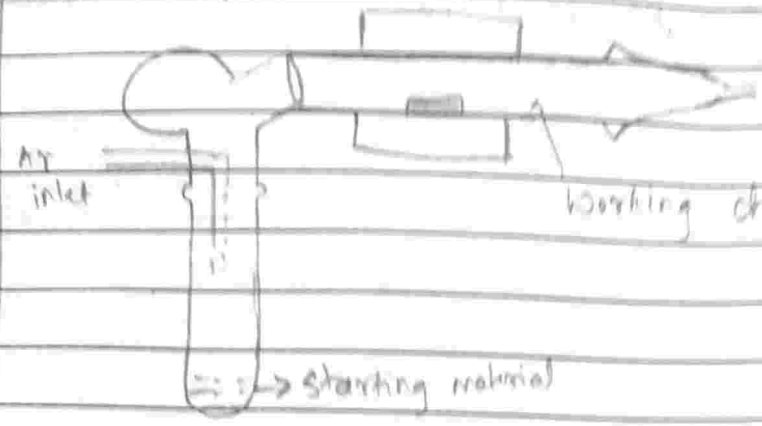
Metal oxides film of like Al_2O_3, CuO, In_2O_3 are deposited by decomposition on glass substrate.



Ar is passed through the inlet as shown in fig.
Ar flow rate is adjusted such that the fine Ar particles flow into the starting materials & ~~then such~~ so the starting elements should enter the working chamber.
The temperature is kept at 420k
The thickness of the ~~film~~ film of on substrate is 10-20nm.

low pressure CVD is used to prepare the Borophosphosilicate glass film.
~~Some~~ Source materials used for this are Tetraethyl orthosilicate, tetra methyl benziline & tetramethyl propane.
The source materials are volumetrically measured & mixed together to form a ~~solut~~ mixture.
The mixture is delivered to the reactant by using sirin pump.
The exist side of the reactant is heated so that the liquid in it

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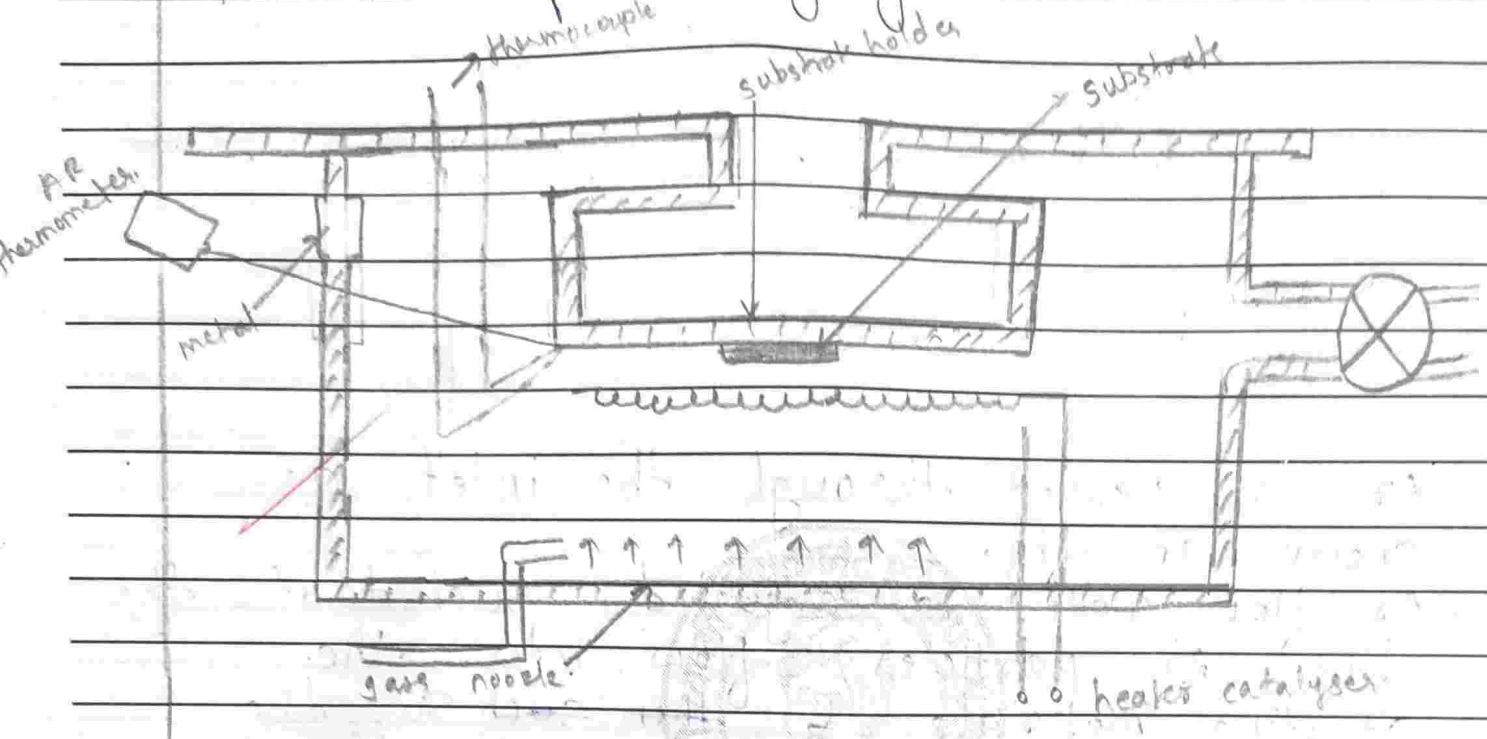
vapourizes.
The vapours fill on the substrate & the thin film is prepared.



other low temperature CVD method is catalyzer experiment which is use to prepare amorphous semiconductor film.
The decompose chamber is made of steel & the film is kept substrate holder is kept such that heat & cool is done by air jet behind it.
The thermocouple is placed near the substrate so that the temperature of it is known.
The heat catalyser is placed Parallel to the substrate holder.
The decomposition takes place & the substrate settle on the substrate or substrat holder kept at center of chamber.
This is used to prepare nitrite films. temperature of 300°k

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Signature of Supervisor	

Suppliment No. :
Roll No. :
Class :

Subject :
Test / Tutorial No. :
Div. :

Q.3.

1. Common CVD reactions:-

Thermal decomposition reaction.

Silane gas is heated to get silicon. The decomposition of silane gas takes place as we used here silane gas.

$$SiH_{4(g)} \xrightarrow{\Delta} Si_{(s)} + 2H_{2(g)}.$$

Same is done to get titanium from TiI_2

$$TiI_2 \xrightarrow{\Delta} Ti_{(s)} + I_{2(g)}.$$

Reduction reaction:

Reduction reaction is gain of electrons. Chlorides are more commonly used halides because they are high volatile & easily purified by fractional distillation. Hydrogen reduction is not applied to certain metals like Ti & Al. because

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their halides are very stable.

$$SiCl_{4(g)} + 2H_{2(g)} \longrightarrow Si_{(s)} + 4HCl_{(g)}$$

Silicon tetrachloride vapors. Through reduction to form silicon.

Similarly for Boron trichloride BCl_3 is as

$$2BCl_{3(g)} + 3H_{2(g)} \longrightarrow 2B_{(s)} + 6HCl_{(g)}$$

Oxide formation:

In this formation oxide films are formed.

SiO_2 is prepared by oxidation of silane with oxygen in atmospheric pressure.

$$SiH_{4(g)} + O_{2(g)} \longrightarrow SiO_{2(g)} + 2H_{2(g)}$$

There is another way of oxidation of SiO_2 by silicon tetrachloride at high temperature.

$$SiCl_{4(g)} + O_{2(g)} \longrightarrow SiO_{2(g)} + 2Cl_{2(g)}$$

As we know oxidation is loss of electrons.

Nitrik & Carbide formation:-

The formation of nitrik & carbide depends of change in parameters like Temperature & pressure.

$$BCl_{3(g)} + NH_{3(g)} \rightarrow BN_{(s)} + 3HCl_{(g)}$$

Boron trichloride is reacted with ammonia

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to get Boron nitrite.
Similarly for carbide formation. for titanium tetrachloride.

$$TiCl_{4(g)} + CH_{4(g)} \longrightarrow Ti\,C_{(s)} + 4HCl_{(g)}$$

Compound formation :-

$$Ga(CH_3)_{3(g)} + AsH_{3(g)} \longrightarrow GaAs + 3CH_4$$

$$6\,GaAs_{(s)} + 6HCl_{(g)} \longrightarrow As_{4(g)} + As_{2(s)} + 6Ga_{(s)} + 6HCl_{(g)}$$

decomposition of compound in 3 to 5 group. forms organometallic reactions.

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Name - Shubhangi Shivaji Kurade D - 16-11-22

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SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 1

Roll No. : 1350

Class : M.Sc II

Subject : Thin Solid films deposition & Properties.

Test / Tutorial No. : Internal exam.

Div. : 17/20.

Q.1

1) → b) $Ga(CH_3)_3 + AsH_3$.

2) Valence shells of nobel gas are completely filled

3) According to electronic concept reduction is defined as process in which an atoms / ions gains one or more electrons.

4) → zirconium

5) CVD thin films are formed on a heated substrate via chemical reaction. & physical rea^n

12

1) The Film preparation are different types.

i) Nakamuna reported has been apply to form amorphous boron nitride film. His set up is controlled by adjustable two leak valves. one is for NH_3 and other one for $B_{10}H_{14}$. The film is deposited on Ta or Si substrate. The substrate is heated to the temperature at 300 - 1150 °C, and deposition time of the film preparation is 30 - 300 minutes. The crystal structure on thin film substrate are studied by x-ray diffraction.

ii) A cold wall low pressure CVD technique. WSi2 it has a vertical cold wall low WSi2 pressure technique. A Vertical bell jar are 24 cm in diameter are used in a reaction as a reaction chamber.

- Graphite sheet coated with silica they act as a heater element.
- The WF_6 is diluted at silane gas (SiH_4) they act as a reacter gas. The substrate temperature tempuratuire is 400°C.

iii) Metal oxide film preparation like Al_2O_3, In_2O_3 the metal oxide film preparation starting material are used they are in fine powder formation. Ar gas flow rate are used as shown in fig:

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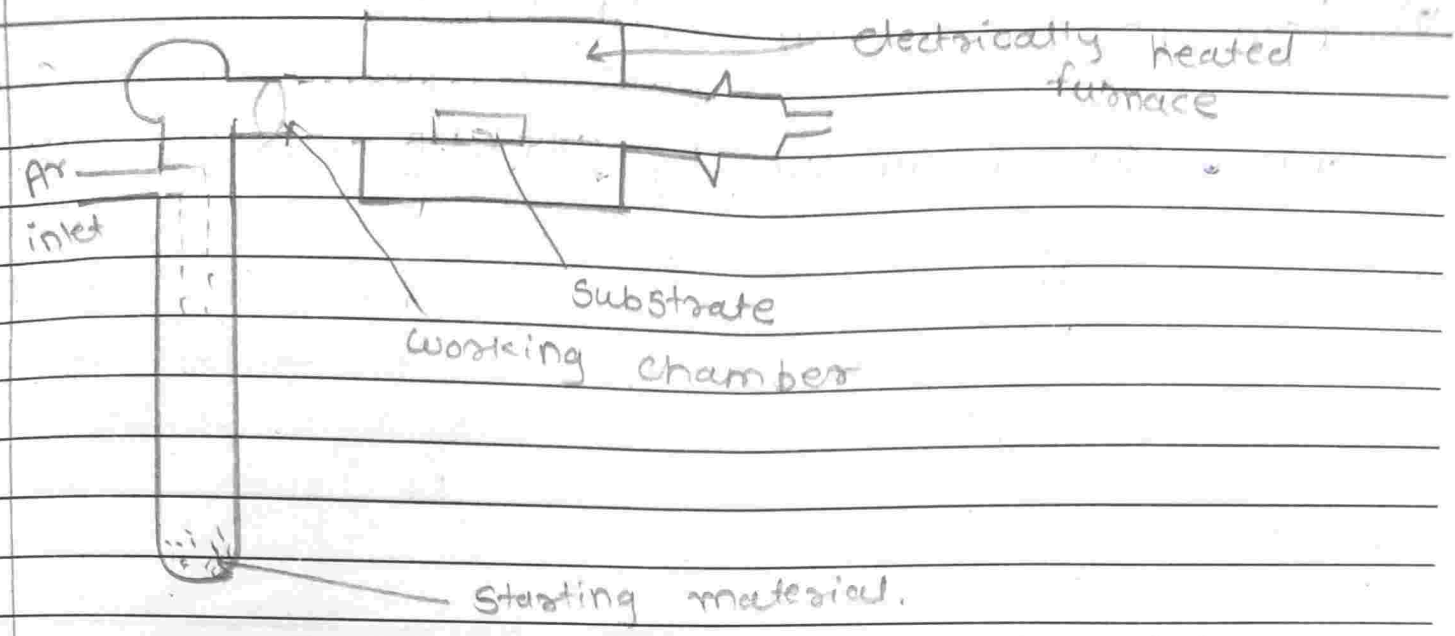

Ar gas is pass through the inlet. Ar particles are comes to the starting material and starting get comes in working chamber. The starting material particles are working chamber. Some particles are settle on substrate and other particles are hold at center of the working chamber. The substrate is in electrically heated furnace at 420°C. The thickness of the thin film is 10 - 20 nm. The substrate is kept at 420°C for 2 Hours. After over a night thin films are annehelate.

iv) ~~Nitride films~~ Low temperature CVD.

low temperature CVD it is the mixture of vapours. The vapor mixture of the ~~nitrides~~ Trimethyl Phosph are deliver at reactor gas by siringe pump. The Glass substrate are used in low temp. CVD of film preparation. The vapors of the mixture are set on the substrate and the thin film was deposited on glass substrate. It is lesed two leak valves. leak valves looses the exist the vapors and settle on substrate

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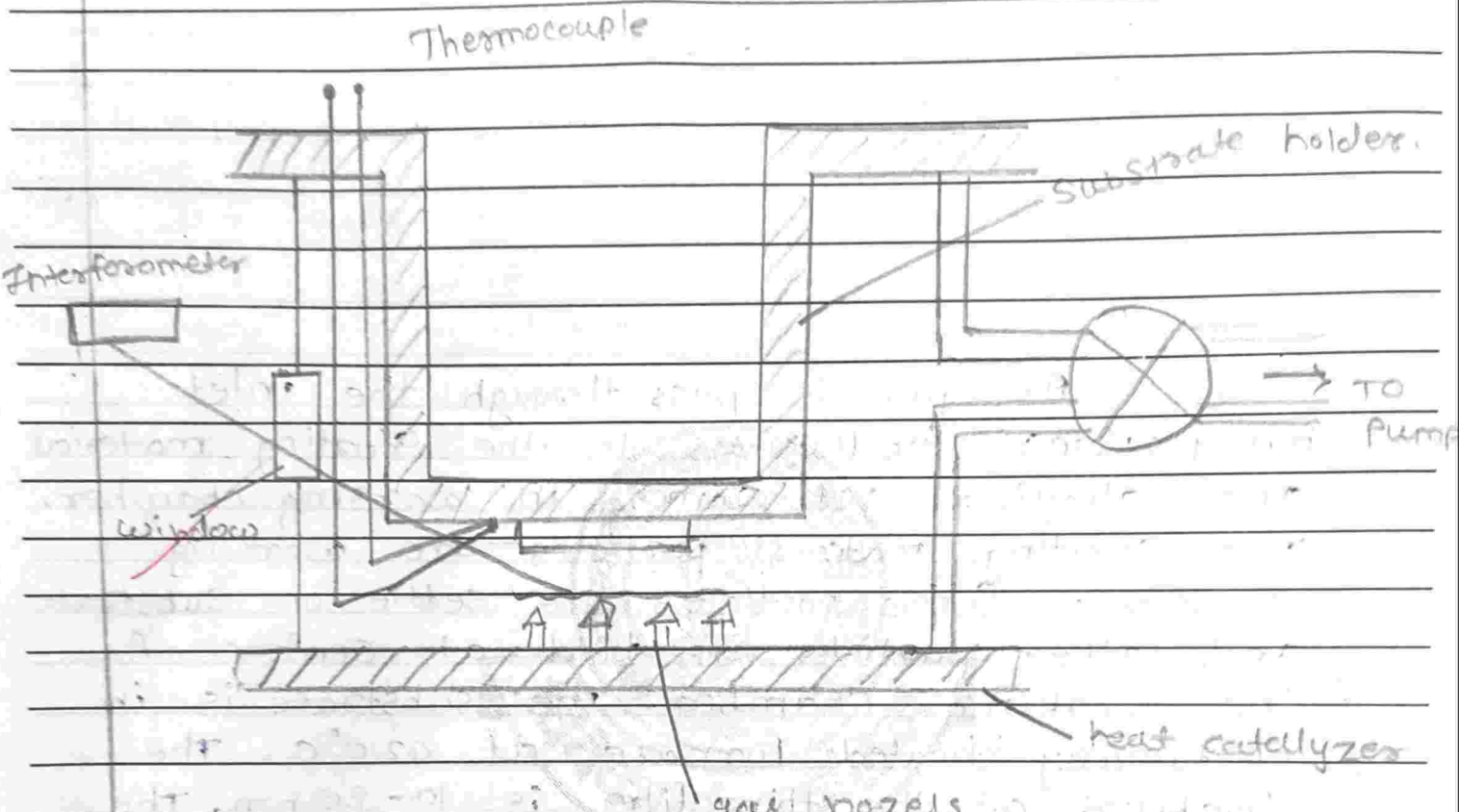
v) Low pressure CVD (LPCVD)

Low pressure CVD is also called Catalytic CVD. It is denoted by CAT CVD or CLT CVD.



-Reaction chamber is made up of steel. In this process. Thermocouple, Substrate holder, gas nozels, heat catalizer. are involved.

The gas nozels are heated to the substrate. substrate holder are kept to the substrate. Heat catalyzer are parallel to the substrate. catalytic rea^n are involved in LPCVD.

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Vivekanand College, Kolhapur (Autonomous)

M.Sc. Part- II (Sem-III) Internal Examination (2022-2023)

SOLID STATE PHYSICS- I

Thin film deposition techniques

Electric & Magnetic Properties

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

Instructions: 1) All the questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labeled diagrams wherever necessary.
4) Use of log table/calculator is allowed.

Q. 1) Select most correct alternative. **(5)**

i) The intensity of magnetization is given by .....
A) M/A 3) m/V C) m/A D) mA

ii) Hall voltage is directly proportional to.....
A) current B) electric field C) magnetic flux D) temperature

iii) Hall effect can be used to determine.... of charge carrier
A) polarity B) temperature C) viscosity D) strength

iv) The ratio of the intensity of magnetization to the magnetizing field H is called as magnetic .....
A) permeability B) susceptibility C) induction D) moment

v) Paramagnetic Curie temperature in Kelvin for iron is equal to .....
A) 2195 B) 495 C) 895 D) 1095

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

i) Explain the cathode sputtering. Discuss the factors affecting glow discharge.

ii) Explain process variables in CVD method. Explain preparation of a Si by photo-CVD method.

Q3. Attempt any One **(5)**

i) What are the applications of plasma enhanced CVD

ii) Explain electron beam evaporation for obtaining high quality films.

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Internal Exam. 2024-25 : Attendance sheet

Paper - TE Technology

~~Name~~ Roll No.	~~Name~~	Marks	Sign.
1331	Ab	Absent	
1332	shraddha sanjay chougule	09	
1333	Ab	Absent	
1334	Aishwarya Suryakant Gaikwad	10	
1335	Divya Ramesh Gaikwad	10	
1336	Gawade Sayali Shantaram	17	
1337	Gurav Rutuja Ravindra	08	
1338	Hirave Pravin Prakash	15	
1339	Nikhil Sandeep Jadhav	08	
1340	Jamadar Wahida Sardar.	10	
1341	Kakade Seema Vishnu	12	
1342	Khandekar Pooja Sanjay	08	
1343	Khokhar Reez Rafiq.	08	
1344	Khot Priyanka Balaso	13	
1345	Ab.	Absent	
1346	Kondare Adinath Bhaskar	14	
1347	Kore Jyoti vinayak	08	
1348	Kshirsagar Vijaya Suresh	05	
1349	Kumbhar Pooja Prakash	11	
1350	Kusade Shubhangi Shivaji	16	
1351	Sammed Rajendra Latthe	12	
1352	Nikam Mounali Tanaji	08	
1353	Aakansha Bhimarao Patil	10	
1354	Anuja Dattajirao Patil	10	
1355	Patil Rajat Jaywant	05	
1356	Sanyogita Sanjay Patil	09	
1357	Shrutika Jaysing Patil	12	
1358	Siddhant Deepak Pirale	16	
1359	Supriya Dhanaji Rajguru	19	
1360	Prerana Pundlik Rajput	08	

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1361			
1362	Sayyad Alsaba Javed	08	Sayyad
1363	Avinash Sanjay Shelar	11	AV
1364	Ab	Absent	Absent
1365	Pooja Vishwanath sutar	09	Sutar

16.11.2021

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15/11/2022

Rajguru Supriya Dhanaji

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19/20 Good

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 01

Roll No. : 1359

Class : M.SC-II

Subject : Thin Film Deposition Technology

Test / Tutorial No. :

Div. :

Q.1)

1) ~~Anti~~ Stokes

2) polarization

3) vibrational

4) Magnetic Field. 05

5) $\Delta E = +g \mu_B B_z$

Q.2)

ii) Electron Spin Resonance Spectroscopy:

- The electron spin resonance in incident ray of photon we get back reflected and scattered.
- The properties of ESR is study we based on unpaired e^- with their technique cases.

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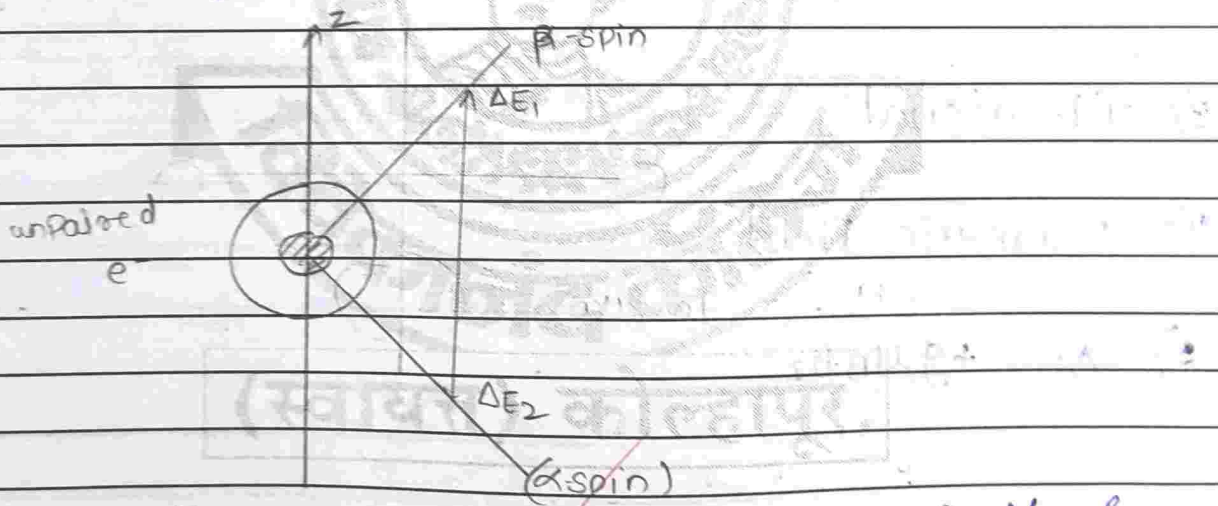
- ESR is absorption of an microwave radiation with unpaired electron with applied strong magnetic field.
- In ESR technique the splitting of magnetic energy level is done due to applied static magnetic field.
- ESR is based upon atomic number of odd number of electron.
  e.g; No, CO_2
- Free radicals are unpaired electrons.
- In ESR technique we used paramagnetic materials.
- The splitting of the energy level is depends on the applied magnetic field.



- when the spin quantum number $S = \pm 1/2$ & spin magnetic spin quantum number $m_s = \pm 3/2$
- If we written as spin angular momentum as,

$$\bar{s} = \sqrt{s(s+1)} \cdot \frac{h}{2\pi}$$

where, $S = \pm 1/2$

$$\bar{s} = \sqrt{\frac{1}{2}\left(\frac{1}{2}+1\right)} \cdot \frac{h}{2\pi}$$

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$$\overline{S} = \frac{\sqrt{3}}{4} \cdot \frac{h}{2\pi}$$

- The magnetic spin angular momentum is given by $m_s \cdot \frac{h}{2\pi}$

Here, magnetic spin momentum, $m_s = \pm 1/2$

- Therefore, the total ~~and~~ spin angular momentum is

$$\sqrt{S(S+1)} \cdot \frac{h}{2\pi} = m_s \cdot \frac{h}{2\pi}$$

- The z - component is orientation angle θ ($\cos\theta$) with splitting of e⁻ unpaired e⁻

$$\sqrt{S(S+1)} \cos\theta \frac{h}{2\pi} = m_s \cdot \frac{h}{2\pi}$$

$$\therefore m_s = \sqrt{S(S+1)} \cdot \cos\theta$$

- The magnetic moment due to unpaired e⁻ is

$$\mu = -g \left(\frac{e}{2m}\right) \sqrt{S(S+1)}$$

Here, g = lande g factor
e = charge of e⁻
m = rest mass of e

$$\therefore \mu = -g \left(\frac{eh}{4\pi m}\right) \cdot \sqrt{S(S+1)}$$

$$\therefore U = -g \mu_B \cdot B_z$$

- we get the energy differences,

$$\Delta E = -g \mu_B \cdot B_z$$

$$= -g \left(\frac{eh}{4\pi m}\right) m_s \sqrt{S(S+1)} B_z$$

$$\Delta E = -g \mu_B m_s B_z$$

Here, $m_s = +\frac{1}{2}$ & $m_s = -\frac{1}{2}$

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$$E_{+\frac{1}{2}} = +\frac{1}{2} \mu_B \cdot B_z$$

$$E_{-\frac{1}{2}} = -\frac{1}{2} \mu_B \cdot B_z$$

$$\therefore \Delta E = E_{+\frac{1}{2}} - E_{-\frac{1}{2}}$$

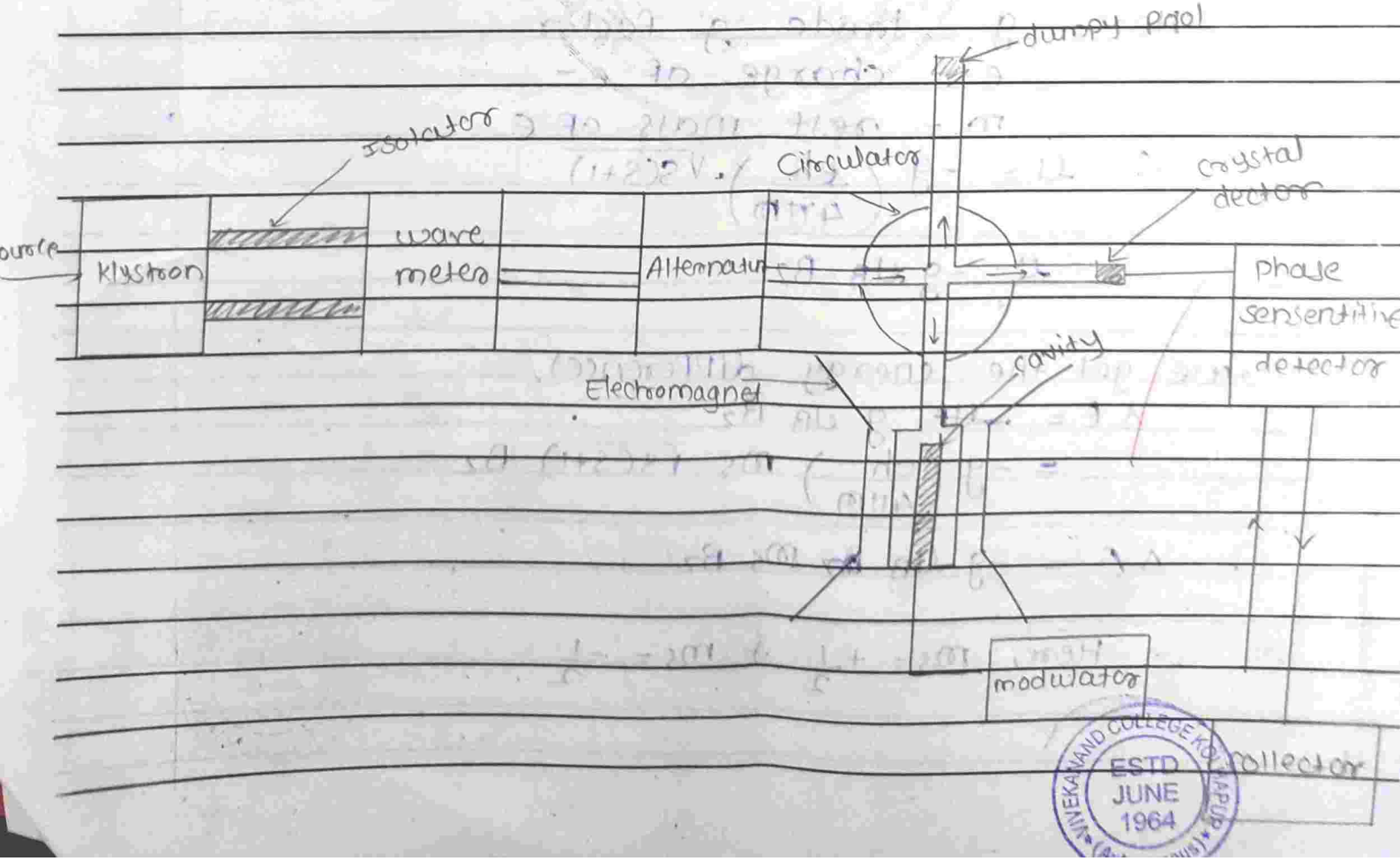
$$\Delta E = g \mu_B B_z$$

But, $\Delta E = h\nu$

$$h\nu = g \mu_B B_z$$

$$\boxed{\nu = g \mu_B B_z}$$

Construction of ESR Spectrometer:



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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 02

Roll No. : 359

Class : M.Sc-II

Subject : Thin Film Deposition technology

Test / Tutorial No. :

Div. :

1) Source :
The input a single of Klystron. They are oscillate a small input. It is pasing through a monochromatic light.

2) Isolator :
~~The~~ ~~Frequency~~ ~~collected~~ ~~and~~ ~~convents~~
It is Fabric material and bielectric filter. Isolator we can generators the ~~sar~~ oscillaton between singles.

3) ware meter :
The frequency single collected and convents the only one direction of single.

4) Alternatur :
The frequency single at provided the low power ~~sam~~ supply. and single paused through the circulator.

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5) circulator :-
The single circulation the to circulated & through out the circulator deetor. crystal detector.

6) cavity :-
The electron spin resonance spectrometer the sample is located.

7) Crystal dector :
The Here crystal dector we used as silicon material. they are incident on sample.

8) Electromagnet :
Here we the homogenous magnetic field they are provides high power supply.

9) phase sensentitive deetor :-
The phase sensentitive deetor is optical device they are measure of phase difference betn the sample.

10) modulator :
modulator it is electric device. They are also used in logic gates.

11) colleetor :
The all single is collect and they are singled by oscilloscope.

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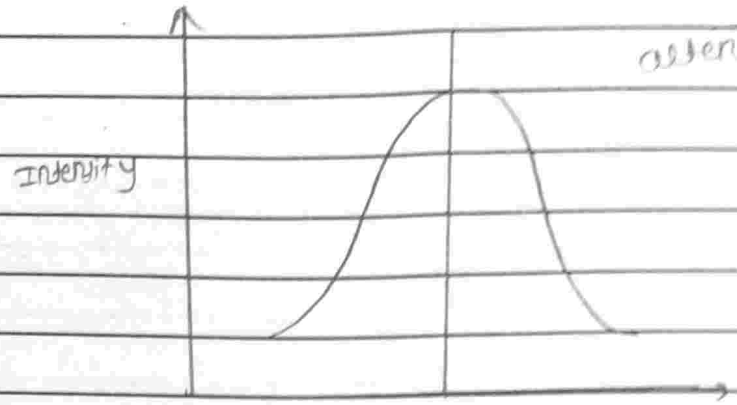
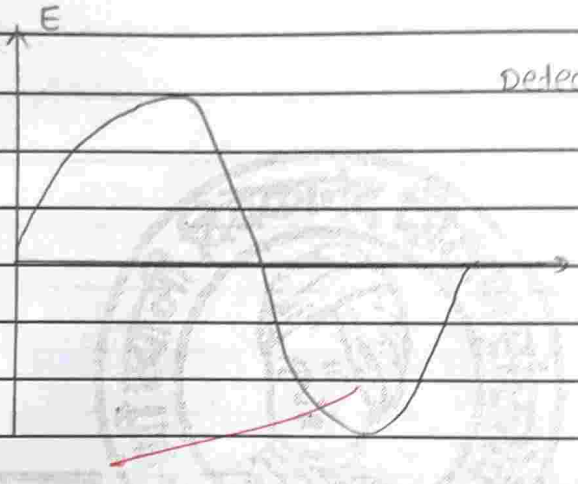
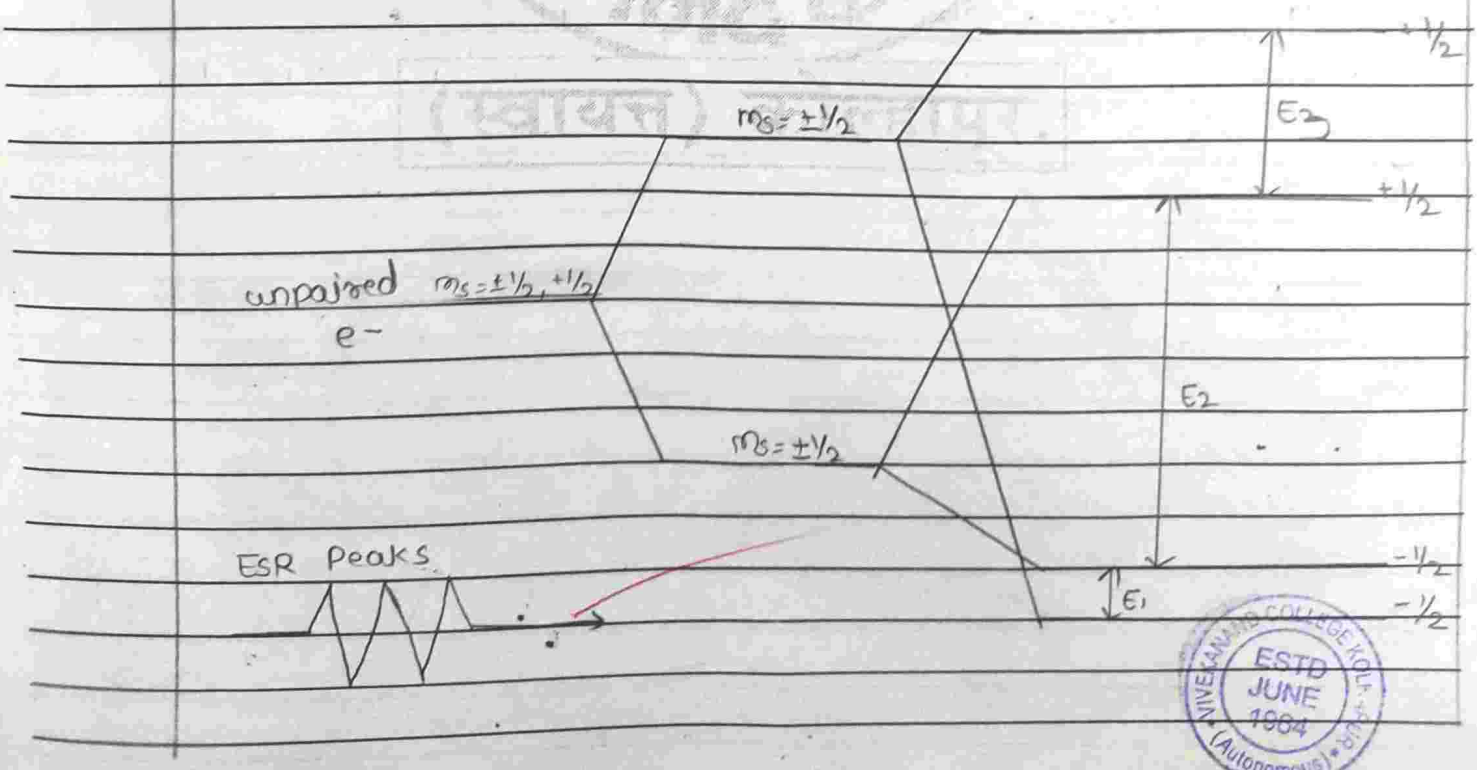




Q.3)

1) ~~Zeeman~~ : Zeeman



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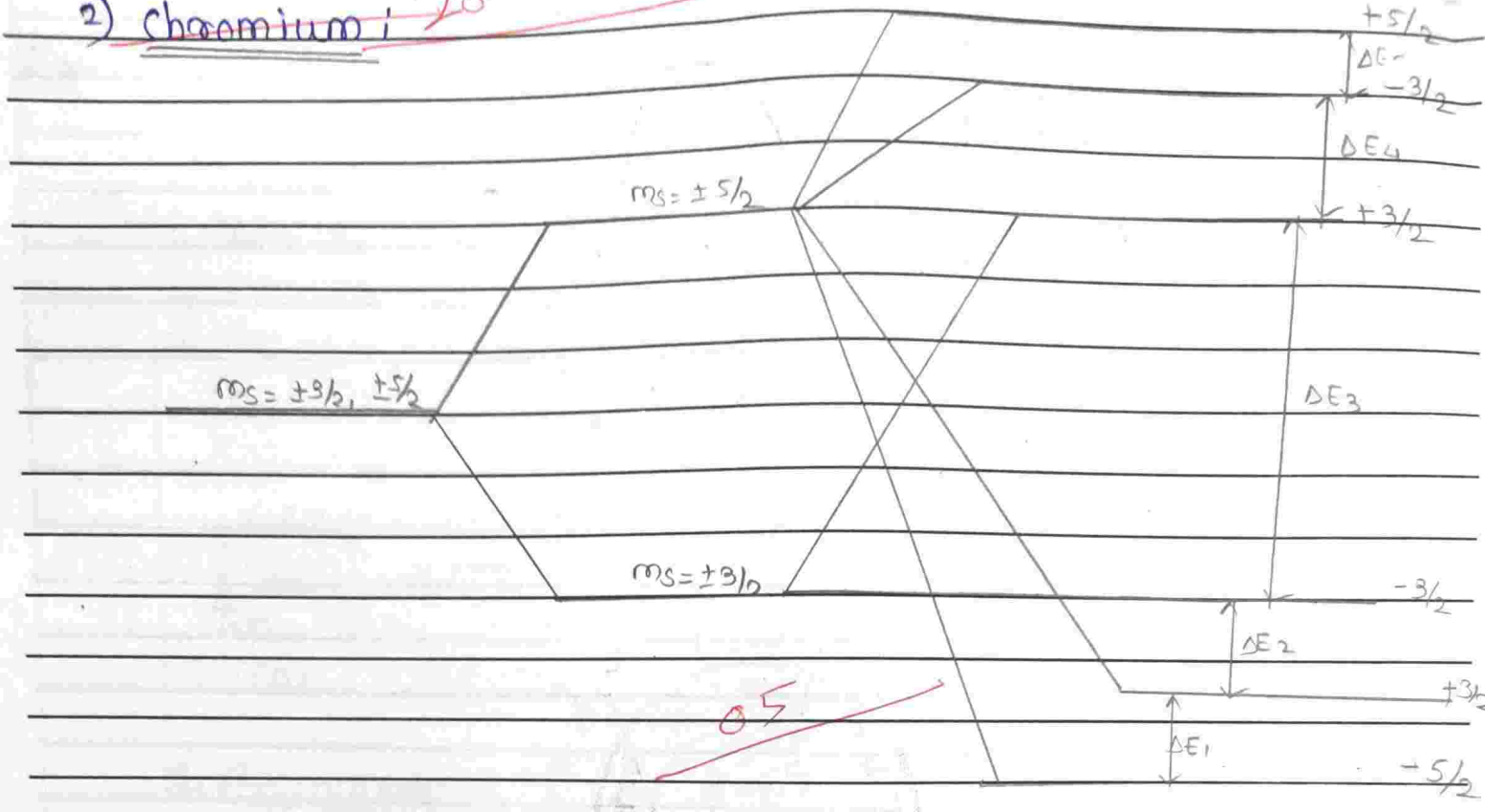
2) Chromium :



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Seat No.

Vivekanand College , Kolhapur (Autonomous).

M. Sc. Part-II (Semester- III) Internal Examination Oct/Nov.2022

Subject: Physics

Title: Semiconductor Physics

Total Marks: 20

Time: 12.00 – 1.00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Figures to the right indicate full marks.
4) Use of Scientific calculator or Log table is allowed.

Q. 1 Select most correct alternative (05)

1. The energy released per fission of uranium is about .....

   a)100 MeV b)200 MeV

   c)400 MeV d) 150MeV

2. For flat spiral spring the angle between plane of spring and axis is .....

   a)60^0 b)45^0 c)90^0 d)180^0

3. X-rays are the ..... waves

   a) electromagnetic b)longitudinal c)mechanical d)elastic

4. According to Weins displacement law.....

   a)λT_{max}=constant b) λT=constant

   c) $\lambda_{max} T$= constant d) $\lambda_{min} T$=constant

5. A perfectly black body is.....concept.

   a) an ideal b) a practical

   c) an achievable d) none of these

Q2: **Attempt any ONE.** (10)

1. Derive the expression for Frenkel defect
2. Derive an expression of intrinsic semiconductor for n-type material.

Q3: **Attempt any ONE.** (5)

1. Explain Bragg's law in reciprocal lattice
2. Explain construction and working of UJT

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Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College (Autonomous) Kolhapur

Department of PhysicsM.Sc. II

2022-23

Attendance Sheet

Paper: Solid State Physics-II

Date:29/11/2022

Roll. No.	Name Of Candidate	Sign
1	Kshirsagar Vijaya Suresh	
2	Kumbhar Pooja Prakash	
3	Kurade Shubhangi Shivaji	
4	Latthe Sammed Rajendra	
5	Nikam Mrunali Tanaji	
6	Patil Aakansha Bhimarao	
7	Patil Anuja Dattajirao	
8	Patil Rajat Jaywant	
9	Patil Sanyogita Sanjay	
10	Patil Shrutika Jaysing	
11	Pirale Siddhant Deepak	
12	Rajguru Supriya Dhanaji	
13	Rajput Prerana Pundlik	
14	Sakate Santosh Shripati	
15	Sayyad Alsaba Javed	
16	Shelar Avinash Sanjay	
17	Sonkamble Rohan Raju	
21	Sutar Pooja Vishwanath	
22	Gaikwad Aishwarya Suryakant	
23	Chougule Shraddha S.	
24	Gaikwad Divya Ramesh	
26	Gavade Sayali Shantaram	
27	Gurav Rutuja Ravindra	
28	Hirave Pravin Prakash	
29	Jadhav Nikhil Sandeep	
30	Jamadar Wahida Sardar	
31	Kukade Seema Vishnu	
32	Khandekar Pooja Sanjay	
33	Khokar Raeez Rafiq	
34	Khot Priyanka Balaso	
35	Kondare Adinath Bhaskar	
36	Kore Jyoti Vinayak	

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Shubhangi Shivaji Kurade D- 16-11-22

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SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 1

Roll No. : 1350

Class : M.Sc II

Subject : Solid State Physics II

Test / Tutorial No. : Internal exam.

Div. :

19/20

Q.1

1) In a 1 cm^3 piece of metal, we have nearly 10^{22} electrons/1 cm^3.

2) NaCl is an Insulater.

3) As the interatomic spacing ~~increases~~ decreases, energy level turns into continuous bands.

4) AlAs is an indirect SC with Band gap 2.16 eV.

5) The fermi dirac distribution law for probability of finding e^- in energy level E is given by

$$\frac{1}{1+e^{(E-Ef)/kT}}$$

.2

6) ~~Electrons and holes in quantum well.~~

1) Direct and Indirect semiconducter :-

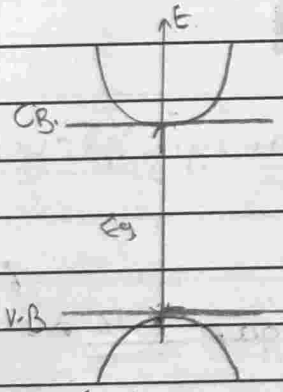
According to the blotch theorem.

$$\frac{\hbar}{2m} + U(r) + \psi(r) = E(\psi(r)$$

The Energy of (E) and ~~Potential en~~ K. diagram it states that the .

There are two types of semiconducter: Direct and indirect semiconducter.

1) Direct Semiconductor :-



1) In direct semiconductor transition between the minima of the conduction band to the maxima of a valence band with same K values.

2) K values of the direct Semiconducter are same.

3) In direct semiconductor energy and momentum of electron are conserved.

4) In direct semiconducter Radioactive recombination are observed.

5) e.g GaAs.

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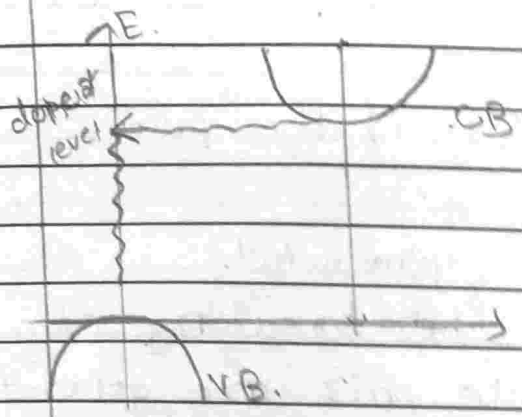
e) Indirect Semiconducter :



1) In Indirect Semiconducter transition between minima of the conduction Band to maxima of valence band with different k values.

2) In indirect semiconductor k values are different.

3) In indirect Semiconducter neither energy nor momentum ~~are~~ of e^- are non-conserved.

4) In indirect semiconductor non-radioactive recombination observed.

5) e.g AlAs.

Q. 9

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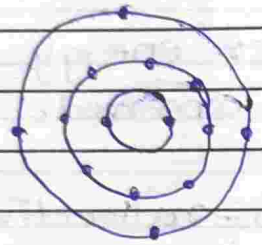
Q. 3

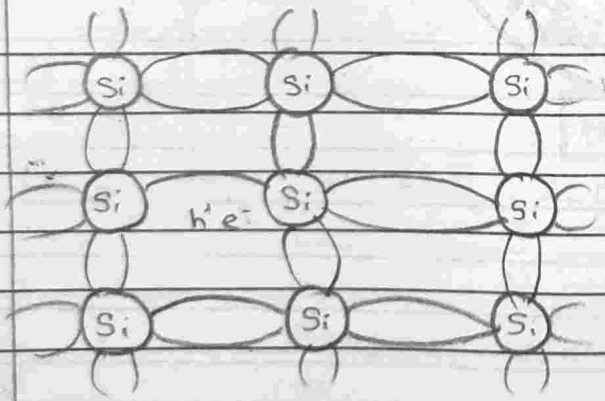
1) Intrinsic Semiconductor :

- Intrinsic semiconductor is the pure form of semiconducter.
- Electron and hole pairs are generated.
- Intrinsic semiconducter due to the breaking of bonding their are electron hole pair are generated
- e.g. Silicon.
- atomic no. of Silicon is 14



Silicon is tetravalent atom.

- In intrinsic Semiconducter Silicon atom are ~~covelent~~ pair to neighbouring 4 atoms.



at 0 K. Band Structure

concentration of e^- in conduction band is equal to the concentration of holes in valence band.

Conc. of e^- (n) = conc. of hole

$n_i = P_i$

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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor :

Suppliment No. : 2

Roll No. : 1350

Class : M.Sc II

Subject :

Test / Tutorial No. :

Div. :

rate of recombination (r_i) = rate of generation (g_i)

- In Intrinsic Semiconducter materials rate of g_i & r_i are time dependent.
- The rate of g_i increase with time.

Extrinsic Semiconducter :

Adding impurities in pure semiconducter to their conductivity they called doping.

In extrensic semiconducter adding impurities with doping their are 2 types of extrensic SC.

1) n-type Semiconducter :

In n-type semiconducter pentavalent impurity added to the pure semiconducter.

e.g Arsenic , P

Silicon atom is doped with pentavalent. valent impurity like Arsenic.

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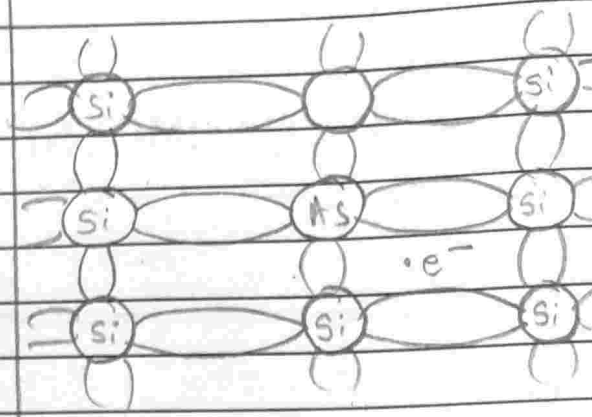
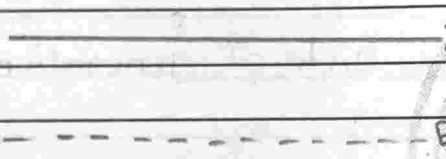


- n-type sc. Si atom are pairing of e^- with neighbouring 4 atoms.
- n-type semiconducter are -ve charged.

- In n type semiconducter electrons are donate to the other atoms.
- Then the n-type semiconducter is donar atoms.

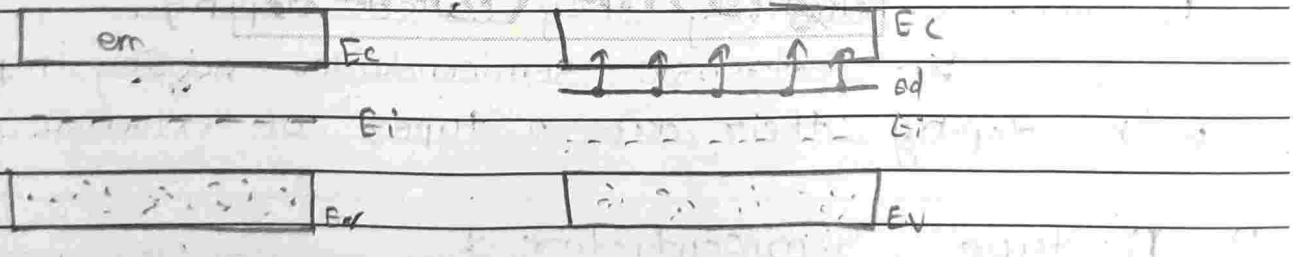


The energy level of the donar atom is called donar level (E_d)

The energy of donar level is above the intrinsic level

Band structure.

- The n-type semiconducter are near to the CB of intrinsic semiconducter.



at 0 K at 500 K

- n type Semiconducter having filled with e^- at 0°K.
- at low temp (50 - 100 K) e^- are boosted to conduction band.

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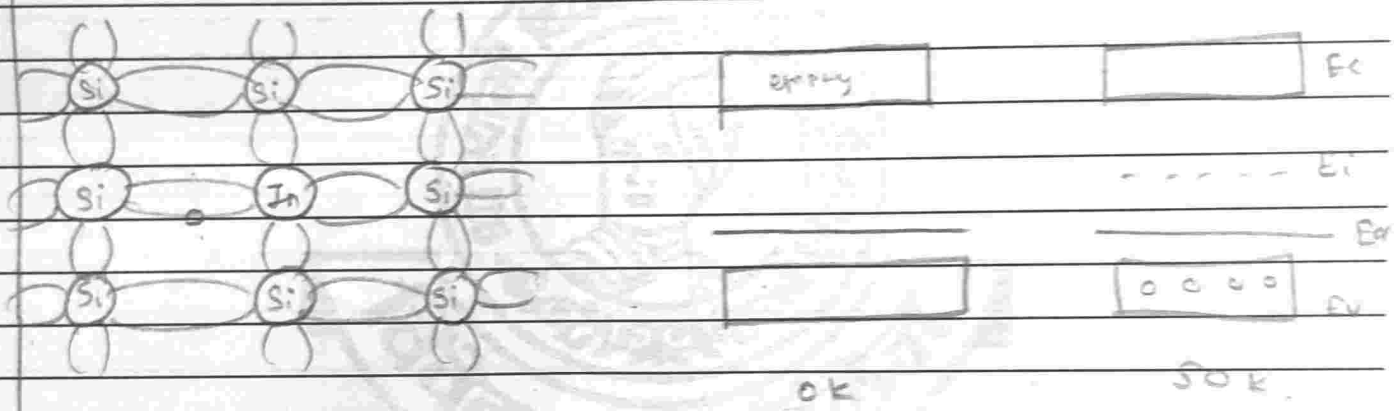
- It is the e^- are majority charge carriers.

2) P- type Semiconducter.

In p-type trivalent impurity added to the pure semiconducter.

e.g Al, Indium, Gallium bismuth



P type Semiconducter are holes majority.

- In p-type Semiconducter holes are majority change carriers and e^- are minority charge carriers.
- In p-type Semiconducter the atems are accept the electron then it is called acceptor atem.
- ~~Energy of the~~ p-type SC are near to the valence band.
- Energy of the acceptor atom are known as acceptor level (Ea)
- In p-type semiconducter majority are holes.
- e^- are ~~in~~ jump to CB from valence ~~band~~ holes are created.

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iv) Amphoteric Materials :-

$p_o >> n_o$ $\qquad$ $n_o >> n_i$

$n_o p_o = n_i^2$

mass action laws

This obeys both intrinsic & extrinsic S.C.

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Miss. Priyanka Balaso Khot Date: 16/11/2022

" ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार "

-शिक्षणमहर्षी डॉ. बापूजी साळुंखे

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. :

Roll No. : 1344

Class : M.Sc-II

Subject :

Test / Tutorial No. :

Div. :

19/20

Q.1

1) c) 10^{23}

2) b) Insulator

A

3) b) Increases.

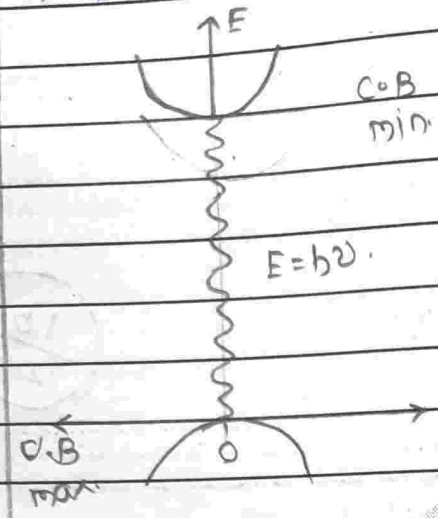
4) d) 2.16

5) a) $\frac{1}{1 + e^{(E-E_F)/KT}}$

Q.2

1) Direct and Indirect Semiconductors:

a) Direct Semiconductor:



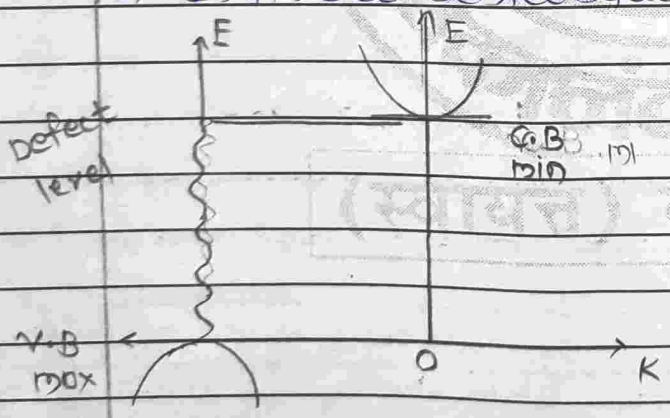
① The transition of semiconductor the maximum of conduction band value to the maximum of conduction band value occurs at same k value (K=0). This is called as direct semiconductor.

② The transitions usually as a radiative recombination It is used in LED's laser. etc

③ The energy and angular momentum of an electrons is conserved.

④ eg. GaAs, AlAs. etc

b) Indirect Semiconductor:



① The transition of semiconductor the maximum of valence band to the minimum of conduction band occurs at different 'k' value. It is called as indirect semiconductor.

② The transitions usually as non-radative recombination.

③ In this transitions, neither energy nor angular momentum conserved.

④ ex. GaP, AlAs, B etc.

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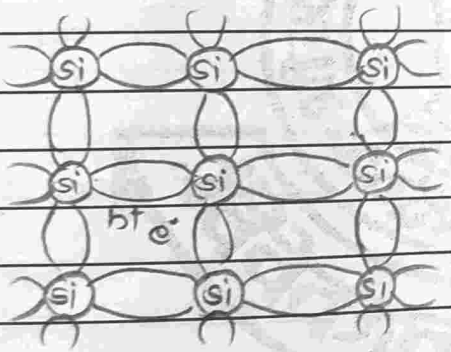
Q.3

① Extrinsic and Intrinsic Semiconductor :

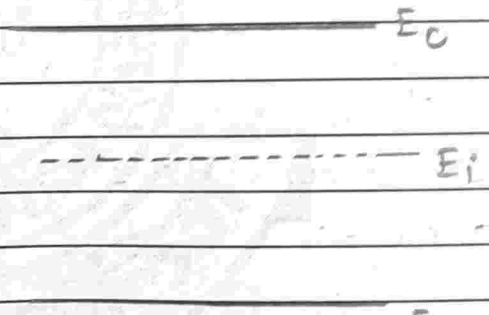
① The Intrinsic semiconductor :

A perfect semiconductor with no impurities or lattice defects is called as intrinsic semiconductor.

- At 0K, Valence band completely filled and conduction band is completely empty. Therefore, there is no charge carrier at 0K.
- But Higher temperature, electron-hole pairs are created. Therefore, the electrons are excited to the ~~conduction~~ valence band the ~~ba~~ access to the band gap to the conduction band. Therefore, electron-hole pair is a charge carrier in intrinsic semiconductor.



Intrinsic semiconductor



Band Structure

The electron-hole pair are generated due to the breaking of co-valent band in crystal lattice of of pure semi-conductor.

- The energy required to break the bond is band gap energy.
- Since, the electron-hole pair is created as the concentration of e's in conduction band is equal to the concentration of holes in valence Band.

$$\therefore n = p = n_i$$

where,

n_i = Intrinsic carrier concentration.

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In steady state, we must have rate of generation,
g_i = rate of recombination (r_i)

where,
r_i, g_i are temperature ~~temp~~ dependent

At any temperature, the rate of recombination (r_i) is directly proportional to the equilibrium concentration of electrons and holes.

$\therefore r_i \propto n_e p_e$

where,
$n_e p_e$ is ~~car~~ equilibrium concentrations of e's and holes

$\therefore r_i = \alpha_r \cdot n_e p_e$

$= \alpha_r \cdot n_i^2$

$\therefore r_i = \alpha_r \cdot n_i^2$

where,
α_r is constant of
which depends on the mechanism of recombination occurs.

Extrinsic Semiconductor:
The process of adding an impurity to pure semiconductor to improve its conductivity is called as dopping.

n-type SC:
When a pure semiconductor is dopped with pentavalent impurity atoms like As, Sb, etc. They have an ionized energy level nearer to the conduction band of pure semiconductor.
-At 0k, this impurity levels are filled with electrons But at low temperature (50k-100)K, the electrons are excited to the conduction band. This level is called