Notice

Date: 11/10/2019

It is hereby informed to the students of M.Sc. – I and II, that First Term Internal Evaluation Examination is scheduled between 25th to26th October 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 afterwords in any case.

Sr. No.	Date	Class	Name of the Paper	Time
01	25/10/2019	M. Sc. – I	(01) Mathematical Physics	12noon – 01 Pm
			(02) Classical Mechanics	02pm – 03 Pm
02	25/10/2019	M. Sc. – II	(01) Nuclear and Particle Physics	12noon – 01 Pm
			(02) Thin Film Deposition and other Techniques	02pm – 03 Pm
03	26/10/2019	M. Sc. – I	(01) Quantum Mechanics I	12noon – 01 Pm
			(02) Solid State Physics – 01	02pm – 03 Pm
04	26/10/2019	M. Sc. – II	(01) Solid State Physics – 01	12noon – 01 Pm
			(02) Solid State Physics – 02	02pm – 03 Pm

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HOD, Physics
Department of Physics
Vivekanand College, Kolhapur.

Seat No.

Vivekanand College , Kolhapur (Autonomous).

M. Sc. Part-II (Semester- III) Internal Examination Oct/Nov.2019

Subject: Physics

Title: Nuclear and Particle Physics

Time - 12 noon - 01 pm Total Marks: 20

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) Primary cosmic rays consist of .. ..
a) Electron b) Neutron c) Proton d) Mesons

ii) Positron was discovered by .....
a) Carl D. Anderson b) J. J. Thomson
c) Ernest Rutherford d) James Chadwick

iii) Deuteron is combination of proton and ..
a) Electron b) Neutron c) α – particle d) Mesons

iv) Which of the following is not fundamental particle .....
a) Electron b) Neutron c) Proton d) α – particle

v) Cosmic rays are produced in .....
a) near moon b) near sun c) in volcanoes d) in outer space

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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Shri Swami Vivekanand Shikshan Sanstha's
Vivekanand College (Autonomous) Kolhapur
Department of PhysicsM.Sc. II
2019-20
Attendance Sheet
Paper: Nuclear and particle physics
Date:25/10/2019

Roll. No.	Name of Candidate	Sign
1	Mr. Bote Sushant Suresh	
2	Miss. Deshmukhe Aishwarya D.	
3	Mr. Deshmukh Mahesh Bhauso	
4	Mr. Jadhav Amit Ashok	
5	Mr. Jadhav Shivprasad Krishnarao	
6	Miss. Kadam Ketaki Vasnat	
7	Miss Patil Manisha Nanaso	
8	Miss Kamble Susmita Chandar	
9	Miss Mandavkar Ruchita R.	
10	Miss Nirmale Pooja Ashok	
11	Mr. Patil Ashutosh Madukar	
12	Miss Patil Asmita Anandrao	
13	Mr. Patil Pranit Mohanrao	
14	Miss Patil Swati Dinkar	
15	Miss Patole Anuradha L.	
16	Miss Phadatare Dhanashri Rajesh	
17	Mr. Sherala Dinesh Naresh	
18	Miss Shinde Amruta Anandrao	
19	Miss Tamke Vaishanavi Namdeo	
20	Mr. Tamboli Asif Jahangir	

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SUPPLIMENT

Signature of Supervisor: 15/11/21

Suppliment No. : –

15/20

Roll No. : 1353

Class : MSC-II

Subject : Nuclear & particle physics

Test / Tutorial No. : Internal examination

Div. :

Q.1 i) The mesons in secondary cosmic rays constitute Hard component

2) A earth's Magnetic poles intensity of cosmic ray is Maximum

3) The number of cosmic rays coming from West is Greater than those coming from east

4) The spin of graviton 2.

5) The leptons are stable except muons

5

Q.2

2) Variation in intensity of cosmic rays.

① lattitude effect.

① The variation of cosmic ray intensity with geomagnetic lattitude is known as lattitud effect.

② It is seen that the intensity of cosmic rays is Max. & practically uniform in the region of Magnetic poles. It decreases more & more rapidly as the equator is approached.

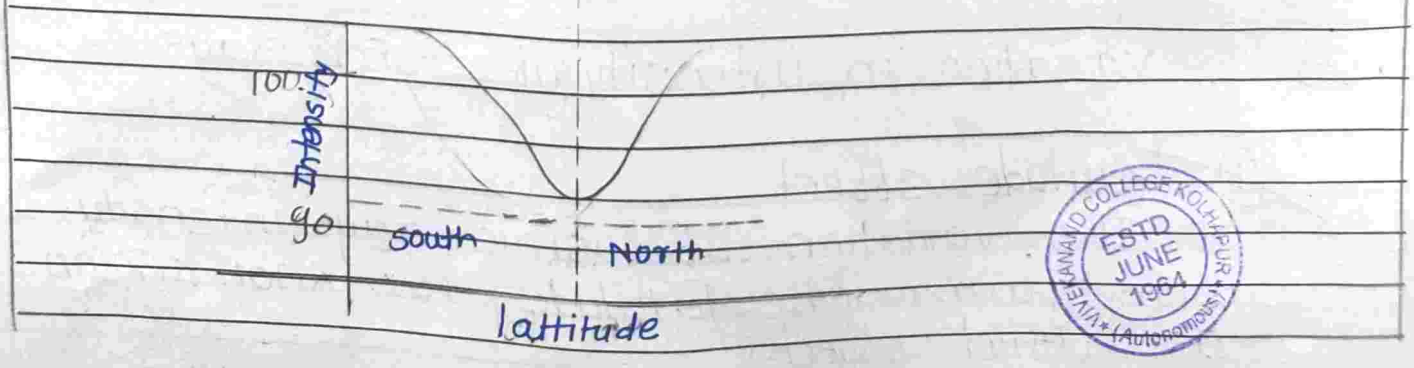
③ at the equator the intensity of cosmic ray particles is Minimum about 10% less than that of the intensity of cosmic rays in terming latitude. Such variation in the intensity of cosmic rays may be easily explained on the basis of earth's Mag. field on cosmic.

④ presence of such effect also provides that the the cosmic ray particles are highly charged particles.

⑤ 1° cosmic particles enters into the earth atmosphere & deflected by earth's Mag. field.

⑥ At the equator the earth's Mag. field is perpendicular to the direction of cosmic ray particles so there is Max. deflection occurs. & so the intensity of cosmic rays is Minimum at the equator.

⑦ At the Mag. poles. the earth's Mag. field is parallel to the direction of cosmic ray particles so there occurs the min deviation so the intensity of cosmic rays is Maximum at the Mag. poles



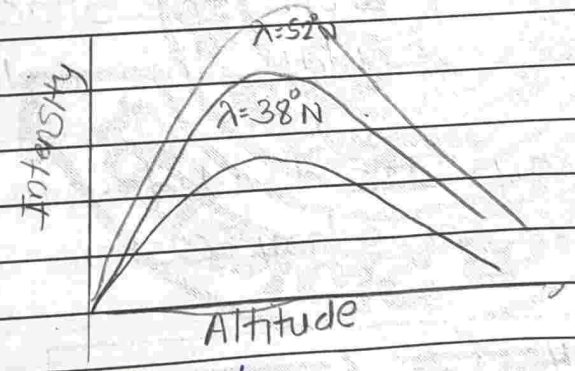
② Altitude Effect.

① The intensity of cosmic rays increases with increase in altitude but not reaches Max. at the top of the atmosphere.

② The intensity of cosmic rays increases with increase in altitude but upto distance above 20 to 25 km. beyond it. intensity again drops

③ The intensity of cosmic rays increase with increase in the geomatric lattitude.

④ The 1° & ~~sett~~ 2° cosmic rays presence in abundance at height. Here these particles enters deep into the atmosphere & Max. absorption takes place. so there intensity again falls.



③ East west Effect.

① It is found that the cosmic rays coming from the west is greater than that of coming from east. this effect is called as Azimuthal effect it is Max. at Equator.

② The no. of cosmic rays coming from the West is 10 % greater than that of coming from east.

③ the 1° & 2° Cosmic rays enters into the atmosphere & deflected by earth's Mag. field

④ According to flemings left hand Rule the positively

charged particles are deflected towards the east & they appear as coming from west.

⑤ i. If Iw & Ie be the intensity of cosmic rays coming from ~~Ea~~ ~~East~~ west & east respectively the East west symmetry is given by Ratio

$$\frac{Iw - Ie}{Iw + Ie}$$

⑧ ~~the ratio is hi~~ high
this has the high altitude as 0.25

1) ~~*~~ cosmic rays

Q.3 The no. of rays coming from the space to the earth's atmosphere everyday. this called as cosmic rays.

These cosmic rays are devided into two types 1° cosmic rays & secondary cosmic rays.

① primary cosmic rays.

1° cosmic rays enters into the earths atmosphere & gets deflected due to earth's Mag. field. 1° cosmic rays present in abundace of height. as they enter into earth's atomosphere deep ~~they are~~ ab there is more absorption occurs & their intensity falls. 1st ly photon enters into atmosphere primary cosmic rays are π^+, π^-, π^0

② 2° cosmic rays.

2° cosmic rays also present abundace of high as they absorbed.

2° cosmic rays e^+, e^-, γ

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SUPPLIMENT

Signature of Supervisor	15.11.21

Suppliment No. :

Roll No. : 1357

Class : M.Sc - II

Subject : Nuclear & Particle Physics

Test / Tutorial No. :

Div. :

16/20

Q1)

1) ⇒ (A)

2) ⇒ (B)

3) ⇒ (C)

4) ⇒ (D)

5) ⇒ (C)

5

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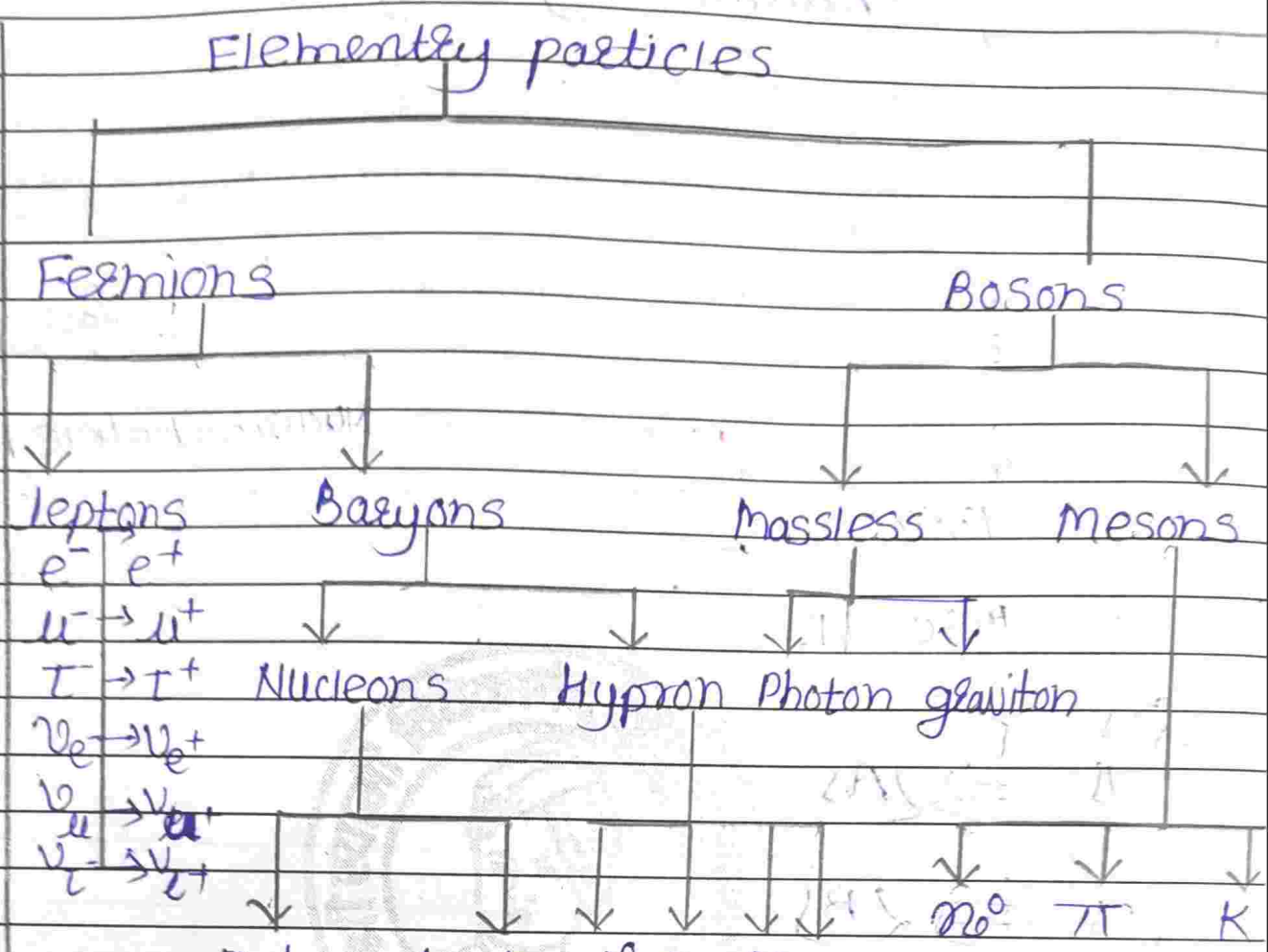
11)



Elementary particles are classified into according to their characteristic property such as mass, spin, charge, lifetime, interaction property, total angular momentum and other various property.

Hence elementary particles are classified as following.

They are classified into

A) Fermions B) Bosons.

A) Fermions ⟹

The elementary particles which have ½ (half) integral spin (½, 3/2 ..) and obeys Fermi dirac state are called as Fermions.

They again classified into.

1) leptons
2) Baryons.

1) leptons ⟶
leptons are light weight elementry particles having a spin is 1/2 so it called as Fermions.
The spin momentum of lepton is $\frac{h}{2\pi}$.

All leptons are unstable except muons. according to these condition leptons are weakly interacting with other elementry particles.
The members of leptons family is $e^-, \mu^-, \tau^-, \nu_e^-, \nu_\mu^-, \nu_l$

i) electron and positron ⟹
The positron is the antiparticles of electron. electron is negatively (-vely) charged and positron is the positively charged electron it is denoted by e^+.
if e^- & e^+ are mutually anhilate with when they are come in contact with each other. and they form 2-γ photons

$$e^+ + e^- \longrightarrow 2\gamma$$

ii) μ-(muons)
μ(muons) is also called as μ-mesons. They exists in both charge such as μ^+ μ^-

μ-mesons are Formed by decaying π-mesons in cosmic rays

iii) Neutrino and ~~Antrino~~ $\Rightarrow$ Antineutrino $\Rightarrow$
Antiparticles of neutrino is called as Antineutrino.

neutrino spin counter in clockwise direction while antineutrino spin counter in anticlockwise direction have been seen.

The member of these Family is π-mesons η^0-mesons K-mesons

2) Baryons $\Rightarrow$

It is the elementry particles having rest mass is equal to greater than corresponding nucleons but less than deteons.

Baryons are composite subatomic particles which contain odd No of valence quarks

* They again classified into
  i) Nucleons
  ii) Hyprons

Baryons spin angular momentum is $\frac{\hbar}{2}$

They are strongly interacting with other elementry particle

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Suppliment No. : 1	Subject :
Roll No. :	Test / Tutorial No. : –
Class :	Div. :

ii) Nucleons

Nucleons exibits both proton and neutron. proton are +vely charged but neutron are neutral.

iii) hyprons →

hyperons is the elementry particles having rest mass is greater than nucleons They are classified as

i) Λ^0 - hypron →

They contain 2 Λ hypron one Λ^0 particles having charge zero and their antiparticle is $\bar{\Lambda}$ having charge -ve.

ii) Σ - hypron →

They contain 6 - Σ hypron These are Σ^+ Σ^0 Σ^- and their antiparlicles is $\bar{\Sigma}^+$ $\bar{\Sigma}^0$

iii) Ξ-hyprons

They contain 4 particles these are Ξ^- Ξ^0 and these antiparticles is Ξ^{-*}, Ξ^{0*}

iv) Ω-hyprons

They contain 2 particles such as Ω^0 and their antiparticles is Ω^-

(B) Bosons ⇒

The elementry particles having zero or integral spin (0, 1, 2, ---) and obeys Bose Finstein State are called as Bosons.

They are classified as

1) massless
2) mesons

1) massless

The particle which has no mass or at rest position or zero mass are called massles

They are divided into

i) photon ⇒ photon have rest mass but have unity spin.

ii) graviton ⇒

The graviton has zero rest mass and they have 2 spin.

2) mesons ⟹

The mesons are hydrohic subatomic particles which is composed of equal No of quarks and antiquarks.

They are subdivided into

i) π-mesons

They contain π^+ π^0 π^- π^+ & π^- are particles and antiparticles of each other while π^0 is neutral has charge is zero

ii) K-mesons

It is the heavier class is mesons. They contain K^+ K^{+0} K^-, K^{-0} elementry particles.

iii) η^0 mesons ⟹

They have central part of mesons ~~nose~~ is stable elementry particle

7

Q3)

2) Antiparticle and pair

particles and Antiparticles ⟹

The apposite charge of very particle are called their antiparticle

The antiparticles of very particles has same mass, spin, lifetime but they have opposite charge. The allgement betn spin & magnetic moment is depends on antiparticle

1) Electron and positron ⟹

positron is antiparticle of electron. electron is -vely charged & positron is +vely charged they denoted as e+.

If e^+ & e^- are mutually anihilate then they gives 2γ proton.

$$e^- + e^+ \longrightarrow 2\gamma$$

2) Proton and antiproton ⟹

The antiparticles of proton is called as antiproton. Proton is +vely charged while antiproton has -vely charged. it denoted as P^-

It has same mass, spin, but opposite charge & momentum

Seat No.

O.P. Code

Vivekanand College, Kolhapur (Autonomous).

M. Sc. Part-II (Semester- III) Internal Examination Oct/Nov.2019

Subject: Physics

Title of the Paper: (Thin film deposition and other techniques)

Subject Code: CBP-1113C

Total Marks: 20

Time - 12 noon - 01 pm

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

Q. 1 Select most correct alternative (5)

i. In laser –CVD process, contamination from other surface is.
A) maximum B) minimum C) average D) zero

ii. SILAR method is . ...method for deposition of thin film
A) physical B) chemical C) sometime chemical D) sometime physical

iii. For precipitation ionic product must be..... solubility product.
A) greater than B) less than C) equal to D) infinity than

iv. Salt bath furnace used to ... the material component
A) harden B) soften C) break D) rough

v. Carburizing process is applied to ... metal
A) harden B) soften C) break D) Rough

Q. 2 Attempt any one (10)

i. Explain the sputtering method for the deposition thin film. Discuss the different methods of sputtering.

ii. Define the furnace. Give the classification of furnace according to type of work.

iii. What are the parameters which affects the furnace atmosphere? How it is controlled?

Q.3 Attempt any one (5)

i. Write note on spray pyrolysis deposition method.

i. Write note on furnaces according to work environment.

ii. Give the distinction between stationary hearth and movable hearth furnaces.

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Vivekanand College (Autonomous) Kolhapur
Department of PhysicsM.Sc. II
2019-20
Attendance Sheet
Paper: Thin Film Deposition and other Technique
Date:25/10/2019

Roll. No.	Name of Candidate	Sign
1	Mr. Bote Sushant Suresh	
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3	Mr. Deshmukh Mahesh Bhauso	
4	Mr. Jadhav Amit Ashok	
5	Mr. Jadhav Shivprasad Krishnarao	
6	Miss. Kadam Ketaki Vasnat	
7	Miss Patil Manisha Nanaso	
8	Miss Kamble Susmita Chandar	
9	Miss Mandavkar Ruchita R.	
10	Miss Nirmale Pooja Ashok	
11	Mr. Patil Ashutosh Madukar	
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16	Miss Phadatare Dhanashri Rajesh	
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SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 1
Roll No. : 1350
Class : M.Sc II

Subject : Thin film deposition Technology
Test / Tutorial No. : Internal exam
Div. :

Q.1

i) In Stokes type of Raman Scattering the wavelength of scattered photon increases than incident photon.

ii) Raman Scattering from classical theory is based on polarization of molecule.

iii) ~~ESR~~ Vibrational Spectroscopy plays a very important role in structure determination of molecule.

iv) In ESR technique the Splitting of magnetic energy level is done due to applied static magnetic field.
→ ~~c) both a & b.~~

v) The energy level difference in ESR Spliting is given by $\Delta E = g\mu_B B_z$.

0.5

Q.2

i) Raman spectroscopy it is the interaction betⁿ the molecules.

Raman scattering are classified into 3 groups

i) Rayleigh Scattering :-

In Rayleigh Scatteing the molecule does not change the energy after interacting with photon.

ii) Stokes Scattering :-

In Stokes Scattering the molecule gains its energy after interacting with photon. wavelength of incident light is less that scattered light. photon looses their energy to the molecule.

iii) Antistokes Scattering :-

In antistokes scattering the molecule looses their energy after interacting with photon. wavelength of scattered light is less than incident light

$d_i > d_s$.

photon gains their energy the molecules.

Stokes Scattering is also greater than Antistokes Scattering.

* Classical theory of Raman Scattering :-

A molecule is placed in a static electric field they get deformation. charges are separated and induced dipole moment is produced. Induced dipole moment is represented as μ_i

the energy of the molecule is directly proportional or depends on induced dipole moment.

$\mu_i \propto E$.

$\mu_i = \alpha E$ — (1)

α = Polarizability Constant.

Then the molecule is place in beam of radiation then the value of energy →

$E = E_0 \sin 2\pi \nu t$ — (2)

Put The ~~molecule~~ value of eq^n (2) in (1)

$\mu_i = \alpha (E_0 \sin 2\pi \nu t)$ — (3)

The molecule are in internal motion of the particle then the polarizability constant get changes. It is in vibratory motion then freq changes.

$\alpha = \alpha_0 + \beta \cdot \sin 2\pi \nu_{vib} t$. — (4)

Put the values of eq^n (4) & (2) in eq^n (1)

$\mu_i = (\alpha_0 + \beta \cdot \sin 2\pi \nu_{vib} t.) \cdot (E_0 \sin 2\pi \nu t.)$

$\mu_i = \alpha_0 E_0 \sin 2\pi \nu t + \beta \cdot \sin 2\pi \nu_{vib} t \cdot E_0 \sin 2\pi \nu t$.

Using Identity.

$\sin A \cdot \sin B = \frac{1}{2} \cos (A+B) - \frac{1}{2} \cos (A-B)$

let, above eq^n becomes.

$= \alpha_0 E_0 \sin 2\pi \nu t + \beta E_0 \frac{1}{2} \cos 2\pi (\nu_{vib} + \nu) t - \frac{\beta E_0}{2} \cos 2\pi (\nu_{vib} - \nu) t$

Then the equation becomes.

$$\mu_i = \alpha_0 E_0 \sin 2\pi \nu t + \beta E_0 \tfrac{1}{2} \cos 2\pi (\nu_{vib} + \nu) t - \beta E_0 \tfrac{1}{2} \cos 2\pi (\nu_{vib} \pm \nu)_t$$

Rayleigh · Antistokes · Stokes

$\alpha_0 E_0 \sin 2\pi \nu t$ ∴ it is the Rayleigh - scattering.

$\beta E_0 \tfrac{1}{2} \cos 2\pi (\nu_{vib} + \nu) t$ ∴ it is the antistokes scattering

$\beta E_0 \tfrac{1}{2} \cos 2\pi (\nu_{vib} - \nu) t$ ∴ It is the stokes scattering

The value of frequency of Antistokes scattering is High.

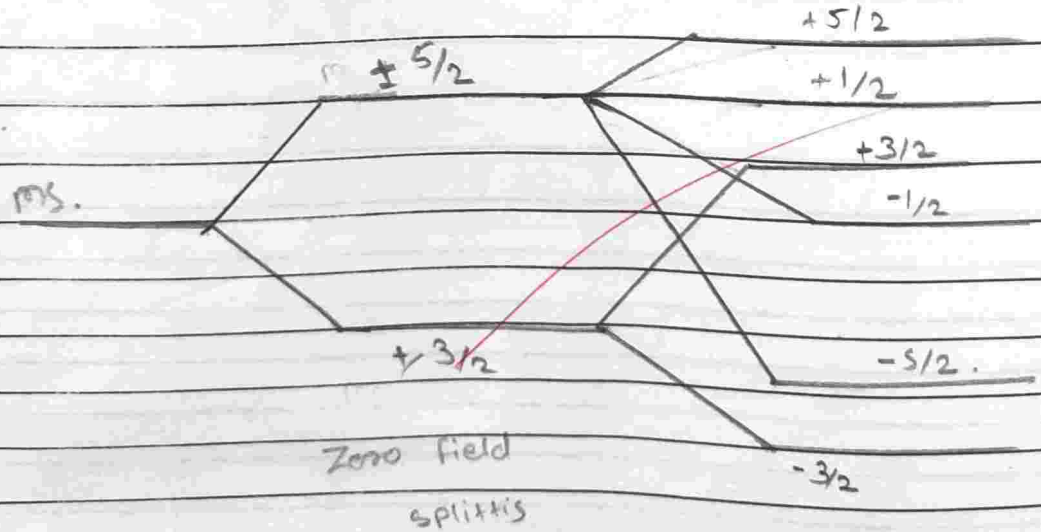
The value of frequency of stokes scattering is Low.

The value of frequency of Rayleigh scattering is medium.

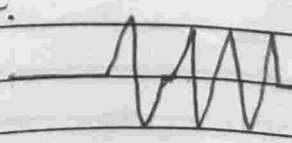
Q.3

ii) Transition Spectra of iron :-

$I = \pm 3/2$ & $\pm 5/2$

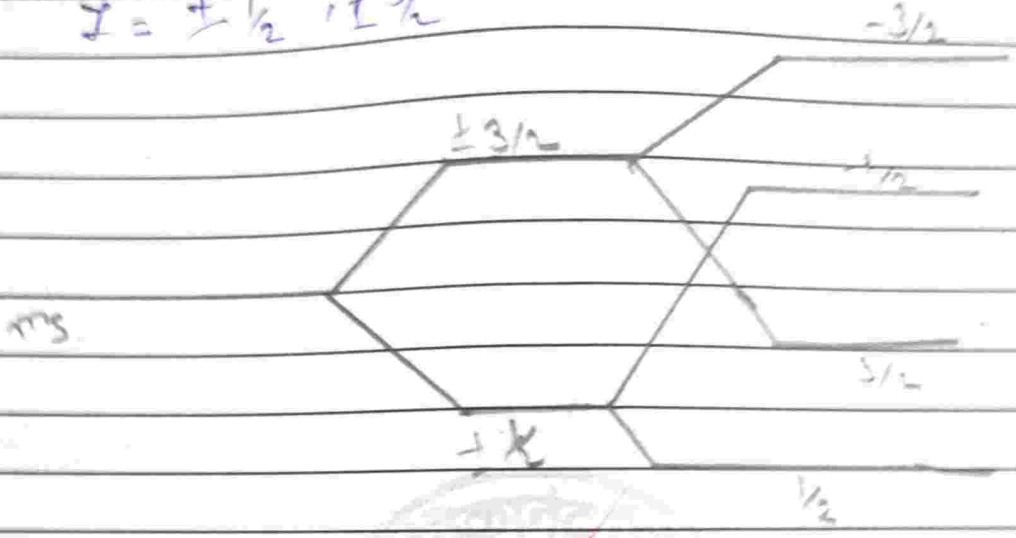


ESR Spectrum :-



Transition Spectra of Chromium.

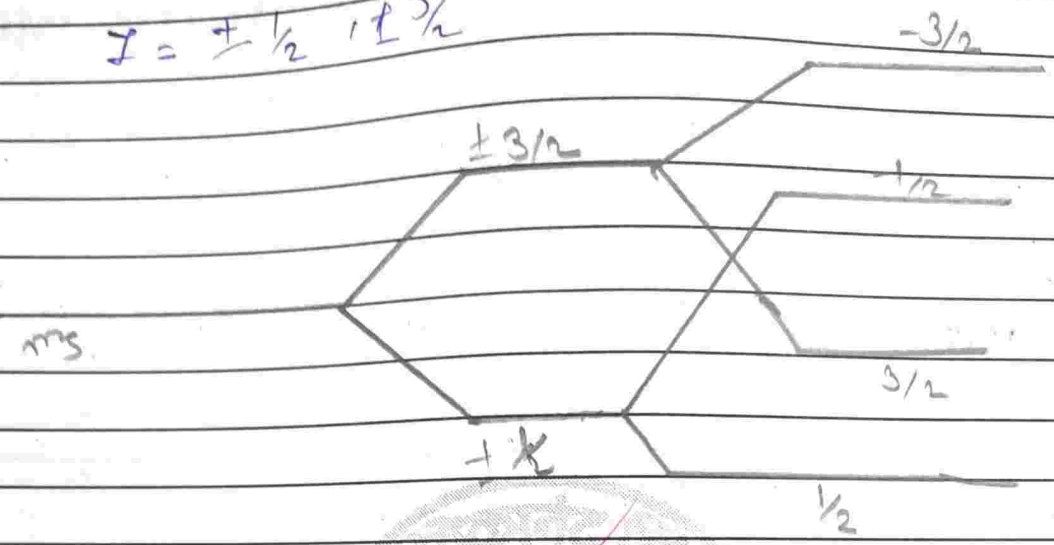
$I = \pm 1/2, \pm 3/2$



ESR Spectrum :-

Transition Spectra of chromium.

$I = \pm 1/2, \pm 3/2$



ESR Spectrum :

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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

19/20

SUPPLIMENT

Signature of Supervisor	

Suppliment No. :

Roll No. : 1346

Class : M.Sc-II Sem-III

Subject : physics paper-IV

Test / Tutorial No. :

Div. :

Thin Film Deposition Technology

1) Anti-stokes

2) energy.

3) ESR

4) both (a) & (b)

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

6/7

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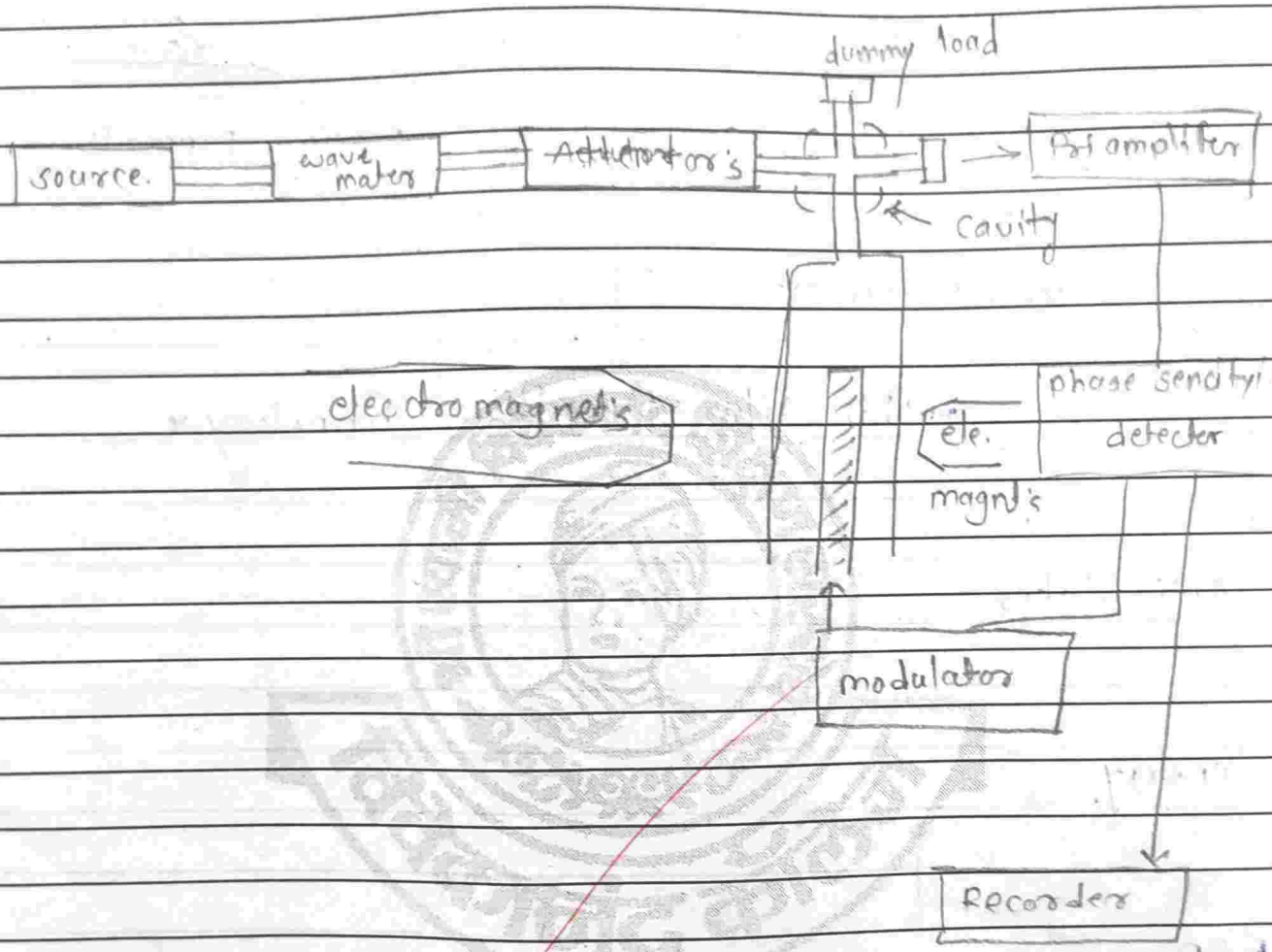
ESR. Spectroscophy

Diagram / Construction of ESR



The above formation of Electronic Spin Resonce are the difection in the spectroscophy by the ESR tecqnicks

In the above construction we are find the exact of the matteral, osillation, leght, level. & the Interferometra matteral all the anylats is givin the below

working -

By the working of the ESR are below terms as follows.

1] **Source** -

In the ESR spectroscopy is manily light is will be used in monocromatic light are used in the wave of small rearge of frequency diff- -ction in the Gouce are passe through the the microwave region's

2] **Insalator** -

In the ESR working tikness like the main part of the microwave will be the trenting in the circuit is the formation the Insult the wave of the next phenomenon is existed.

3] **Waveguide** →

It is the electric direc is will be the used in the ESR spectroscopy is mainly the light of the radition will performing of measure used is R.C circuite like used.

4] **Attenators** -

It is the also dive of the electrically formation in used of ESR spectroscopy.

It main purpose of attentors is the adjesting the level of of spectral beam/light in the constriction in the intraction light.

5] **Sample cavity** → These are the ESR cavity of the given constricom's is used like

(6) circulator :-

In the ESR spectroscopy is will the mainly the beam / light are exactly actualy indicates of the well shaped / size like phenomenon is the forming in circulator.

(7) phase sensitivity ditector :-

In the ESR spectroscopy tekneki's are phase senitivity ditecter is main roal of is the like interferometer is the sensitivity is the detection of the indication.

8 Electromagnet's :-

In the ESR spectroscopy is the the actully High electric sensitive is two side's magnet's are formation in a Homogenous electric filled will performing

(9) Modulator :-

In the ESR teeckniki's are modulater is diticon is the modulas, indicator of the etc. phenomenon is the condition of ESR.

(10) Recorder :-

In the all the phenomenon is completed of the osillation or Recooded part is Rocoorderd.

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Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

M.Sc. Part-II SEM III Internal Examination

SSP 1 : Thin solid films Deposition and Properties

Paper code:CC-1114C

Date: - 26-10-2018
Day: - Wednesday

Total Marks: 20
Time :- 12 noon- 1 pm

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. Thin films of GaAs deposited by CVD are best made by which of the following reaction at appropriate temperatures?
   a) Ga+As b) GaH_3+AsH_3 c)$GaMe_3+AsH_3$ d) $GaPh_3+AsH_3$

2. Valence shells of noble gases are ----
   a) Partially filled b) Completely empty c) Half empty d) Completely filled

3. According to electronic concept reduction is defined as the process in which an atoms or ions ---- one or more electrons.
   a) Loses b) Gains c) Both (a) and (b) d) None of the above

4. Which of the following is not halides ----
   a) Astatine b) Bromoethane c) Zirconium d) Tennessine

5. CVD thin films are formed on a heated substrate via a ---
   a) Chemical reaction b) Physical reaction
   c) Both (a) and (b) d) None of the above

Q2. Answer the following (Any one) (10)

1. Explain the methods of film preparation.
2. Draw neat diagram and explain the working of photochemical vapor deposition.

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

1. What are Comman CVD rections and explain principle of each.
2. Write a note on Laser CVD.

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Vivekanand College (Autonomous) Kolhapur
Department of PhysicsM.Sc. II
2019-20
Attendance Sheet
Paper: Solid State Physics-1
Date:26/10/2018

Roll. No.	Name of Candidate	Sign
1	Mr. Bote Sushant Suresh	
2	Miss. Deshmukhe Aishwarya D.	
3	Mr. Deshmukh Mahesh Bhauso	
4	Mr. Jadhav Amit Ashok	
5	Mr. Jadhav Shivprasad Krishnarao	
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15	Miss Patole Anuradha L.	
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Signature of Supervisor	

Suppliment No. :

Roll No. : 1358

Class : MSc-II

Subject : Thin solid films deposition and properties

Test / Tutorial No. :

Div. : 15/20

Q I)

1) $Ga(CH_3)_3 + AsH_3$

2) ~~Completely~~ Partially filled

3) Gains

4) ~~Astatine~~ 3

5) ~~Chemical reaction~~

Q III)

⇒1) Common CVD reactions.

a) The vapour enters the chamber and reacts with the gases present in the chamber and forms a solid film on the substrate.

b) The substrate is maintained at certain temp

c) Three main steps are involved in CVD reaction.

i) Transportation of reactant gases

ii) Heat supplied to the reactant

iii) Removal of byproduct.

d) The temperature of substrate is maintained by controllable variables like deposition temp, geometry of chamber, flow rate

e) The reactor chamber is classified into two types

i) Atmospheric pressure

ii) Low pressure

f) In atmospheric pressure it requires large no of apparatus larger temp, large contamination

g) In low pressure it requires reactant gases in small amount at low pressure

h) The reactor chamber is divided into two groups

i) Hot wall

ii) Cold wall

i) In hot wall heat is supplied to whole chamber

j) In cold wall heat is supplied to substrate only.

k) There are 5 main reactions those are as follows.

A) Thermal decomposition.

When Silane gas (SiH_4) is thermally heated gives silicon and hydrogen as byproducts.

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

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

B) Reduction reaction.

~~It is not possible to~~ Each time it is difficult to use hydrogen gas for deposition ~~hce deposition~~ on metals like aluminium etc.

As a result chlorides are used generally due to their higher volatility

When silicontetrachloride is reacted with hydrogen gas gives silicon and HCl

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

C) Oxidation reaction

This technique is used to form oxide films. When silane gas is reacted with oxygen, silicon dioxide is formed giving hydrogen gas

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

D) Nitrite and carbide formation.

When ~~tribro~~ Bromotrichloride is reacted with ammonia it gives boronitrite and ~~methane~~ HCl gas as products

$$BCl_{3(g)} + NH_{3(g)} \longrightarrow BN_{(s)} + \cancel{CH_3} \; 3HCl_{(g)}$$

E) Compound formation.

When $Ga(CH_3)_3$ is reacted with AsH_3 it gives Gallium-arsenite and methane gas

$$Ga(CH_3)_{3(g)} + AsH_{3(g)} \longrightarrow GaAs_{(s)} + CH_{4(g)}$$

Q II)

→ 1) Methods of film preparation

a) Formation of Boronitrate

i) Nakamura was the scientist that discovered this technique

ii) The substrate temp was maintained between 300°C – 1150°C.

iii) The substrate was of Tantum (Ta) or silicon (Si)

iv) Time consumed in the reaction was 30 – 300 mins.

v) Two leak walls of NH_3 and $B_{10}H_{14}$ (Decaborane) were produced.

TEOS TMP TEOS

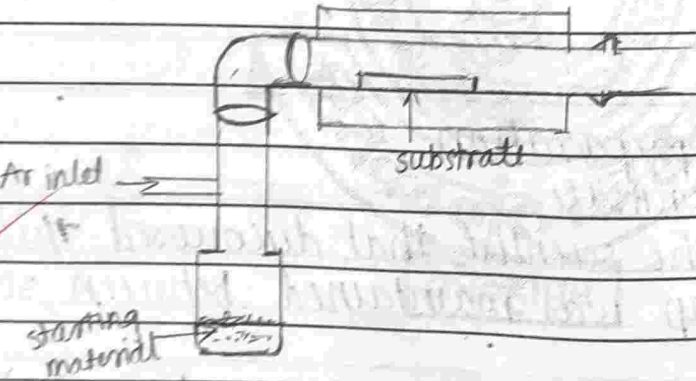
b) Formation of (WSi_2)

i) In this technique film of Tungsten disilicate was formed

ii) Quartz bell jar having a diameter of 24 cm was used as the chamber.

iii) Cold wall

c) Preparation of Al_2O_3 / CuO.



i) Here Ar gas was supplied through the inlet value into the chamber.

ii) Starting material was used in the form of powder.

iii) When Ar gas was inserted the starting material was carried by the gas and the powder was stricked at the walls of chamber.

iv) The substrate was mainted at certain temp with the help of electrically controlled

v) Due to this the powder was vapourized and then film of 10-20nm was formed on the substrate

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Roll No. 1358

Class MSC-II

Subject :

Test / Tutorial No. :

Div. :

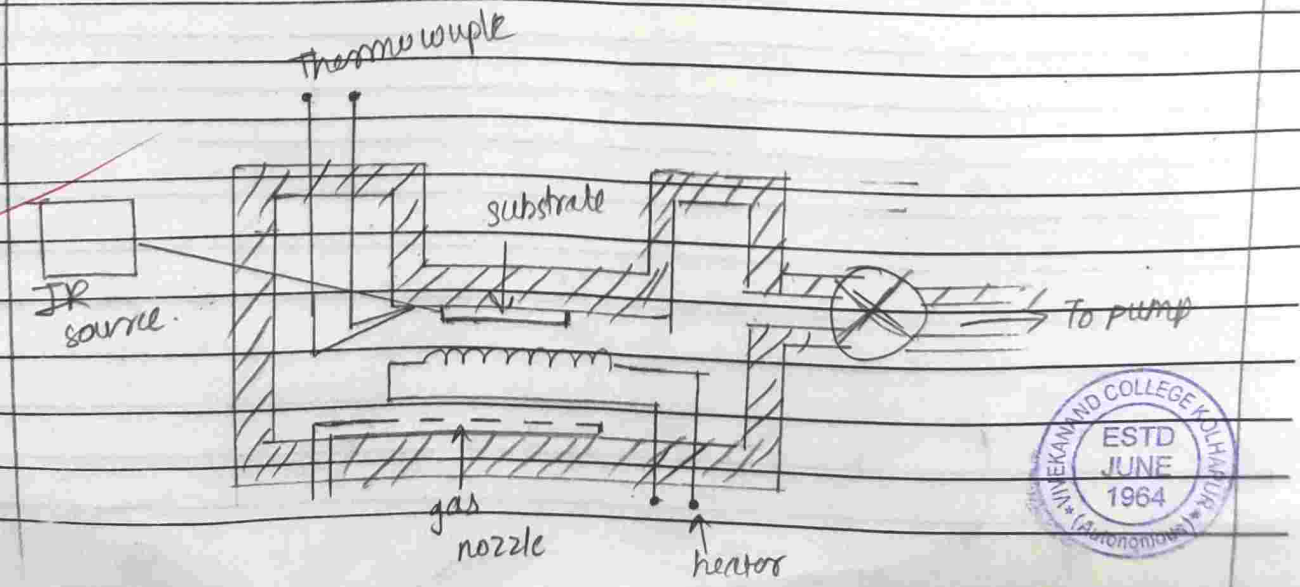
iii) The substrate used here is of n-type Si-waffer.
iii) The reaction time was 2hrs
iiii) The temp of substrate was 420°C.

d)

i) Tetraethylorthosilicate (TEOS), trimethylphosphate (TMP) trimethylsulphate (TMS) were used as source gas
ii) These were measured volumetrically and mixed

67

e)



i) The chamber is made up of steel
ii) The substrate was attached to a substrate holder.
iii) Gas nozzles were used to heat or cool the substrate.
iv) Thermocouple was used to measure temp of substrate.
v) A heater was used to heat the substrate.
vi) The gas was passed through the gas nozzle by which vapours were formed and deposited on substrate.
vii) Then the remaining gas was passed through the outlet towards pump.
viii) This technique is used to form nitrites.

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SUPPLIMENT

Signature of Supervisor	

Suppliment No. : 1
Roll No. : 1349
Class : M.SC - II

Subject : solid state - I
Test / Tutorial No. : Internal exam
Div. : - 15/20.

Q.1

1) → $Ga(CH_3)_3 + AsH_3$.

2) ⇒ Valance shells of nobles gases are completly filled

3) ⇒ Gains.

4) → Astatine.

5) → Chemical Reaction.

Q.2

2) Photochemical Vapoux deposition.

→ ⊙ the photochemical Vapoux deposition is used high quality damag of film.

⊙ the Atvantages of this techniques is Low temp, fastes deposition tate. higly decompotion pressuxe, & junction foxmation.

⊙ As comaxable to photo, CVD. plasma.

⊙ photo CVD aee no highly enexgetic souxce.

⊙ higly enexgetic photo photochemical decomp-otion it's them.

⊙ the photochemical decompotion achived by ultxavoilet lamp.

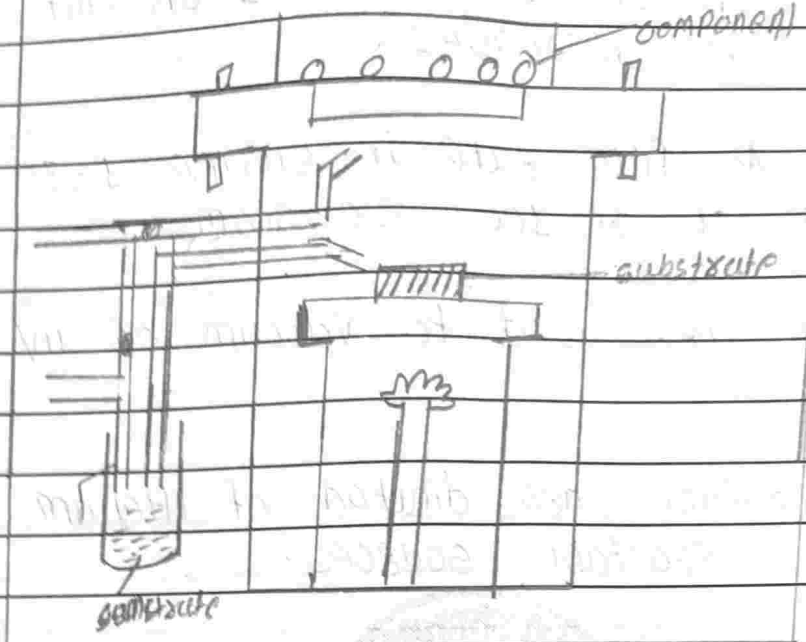
⊙ the photochemical decompotion is used to wavelegth of incident eadiation.

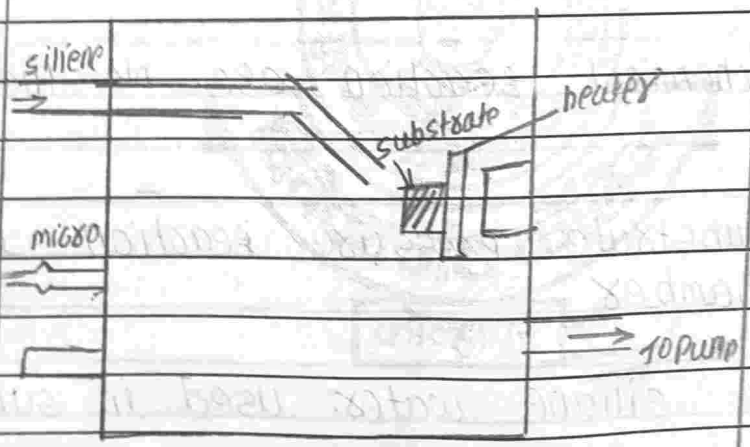
⊙ the film is a metal, is Pxametexs like Vapoux metal, dielectxic metal, insulatox & compound semiconductox.

⊙ the atomosphexe is mexcuy is used as a UV light souxces.

⊙ the Low temp of Hg is 2537 to 1849 Å

- The deposition of 45°A per 1 cm^3 unit is Hg temp is increases.
- 20 - 200 At film rate is silicane 1 - 30 sccm & film rate of 100 - 700 sccm.
- microwave are used to vaccum of UV light source.
- The Di - siliane are diluted of Helium is used as reactant sources.
- The Si (silicon) & I_2 & used film is deposite to 50°C to 750° sccm.
- The photochemical reaction are No thermal energy.
- The all substrate pressure reaction in reactor chamber.
- glass or siliane water used in substret.
- The substret temp is 50° to 300°C
- The mixture of two sol" is indepent of source.
- The Advantages is. therer temp low & faster deposition rate.





Q.3

1) Comman CVD Reation.

→

- ⊙ the vapour mixture is unreacted Reaction.
- ⊙ the chemical Reaction in most part of CVD Reaction.
- ⊙ the substrate mainly slite two walls
- ⊙ Two leak wall.

Seat No.

Vivekanand College , Kolhapur (Autonomous).

M. Sc. Part-II (Semester- IV) Internal Examination Oct/Nov.2021

Subject: Physics

Title: Semiconductor Physics

Total Marks: 20

Time - 11:00 am - 12:00 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. For the system of magnetic dipoles the magnetization is given by
   a) $-\frac{\partial U}{\partial H}$ b) $\frac{\partial F}{\partial H}$ c) $-\frac{\partial F}{\partial H}$ d) $\frac{\partial U}{\partial H}$
2. For N particles having f degrees of freedom each, the dimensions of phase space is
   a) N^2 b) h^{fN} C) f^{hN} d) 6N
3. Entropy per system is .....
   a) Always negative b) Always positive c) Always infinite d) Always zero
4. The total wavefunction for Boson is
   a) Symmetric b) Antisymmetric
   c) both Symmetric and Antisymmetric d) not defined
5. The specific heat at constant volume for harmonic oscillator (1D) .....
   a) 3R/2 b) 5R/2 c) R d) 2R

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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Vivekanand College (Autonomous) Kolhapur

Department of PhysicsM.Sc. II

2019-20

Attendance Sheet

Paper: Solid State Physics-2

Date:26/10/2018

Roll. No.	Name of Candidate	Sign
1	Mr. Bote Sushant Suresh	
2	Miss. Deshmukhe Aishwarya D.	
3	Mr. Deshmukh Mahesh Bhauso	
4	Mr. Jadhav Amit Ashok	
5	Mr. Jadhav Shivprasad Krishnarao	
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SUPPLIMENT

Signature of Supervisor	

Suppliment No. : —

Roll No. : 1337

Class : M.Sc II (Physics

Subject : SSP 2 - semiconductor Physics

Test / Tutorial No. : Internal Exam

Div. : —

13/20

Q. 1

1. ✓

→ a) 10^{22}

2. ✓

→ b) Insulator

3. ✓

→ b) increase

4. ✓

→ a) 1.16 eV

5. ✓

→ b) $\frac{1}{1 - e^{(E-F)/kT}}$

Q. 2

1

→

* Direct semiconductor -

① The semiconductor in which the transition of electron from minimum of conduction band to maximum of valence band at same k value, i.e 'o'k.

② The transition of electron in direct semiconductor is radative and recombination. Which is used in the LED's & LASSAR's.

③ The Energy and momentum of an electron in direct semiconductor are conserved.

④ Examples - Ga, As etc.

⑤ At ok value, Valence band is completely filled & conduction band is completely empty.

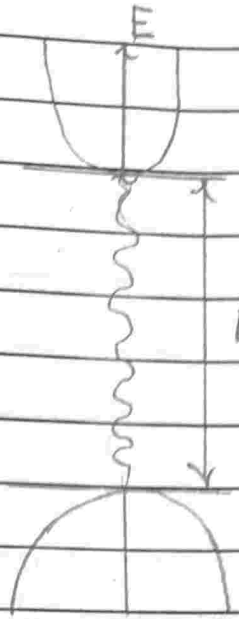

fig (a) e^- transition in Direct Semiconductor

* Indirect Semiconductor -

(1) The semiconductor in which the electron transition from minimum of conduction band to maximum of valence band at different 'K' values called as Indirect Semiconductor.

(2) The transition of electron in indirect semiconductor is non-radative and non-recombination.

(3) In this semiconductor neither energy nor momentum of electron is conserved.

(4) Example -

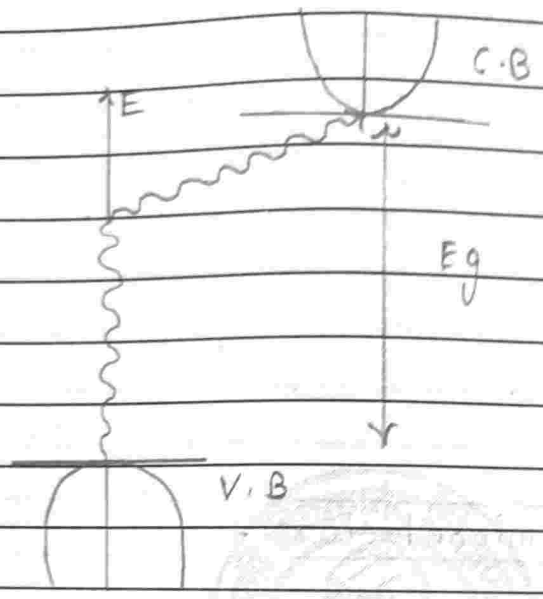

fig (b) electron transition in indirect semiconductor

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Suppliment No. : 1

Roll No. : 1337

Class : M.Sc II (Physics)

Subject : SSP-2

Test / Tutorial No. : Internal Exam

Div. : –

Q. 3

1.

→ Intrinsic semiconductor –

i) The semiconductor in which no impurity is added on it called as Intrinsic semiconductor.

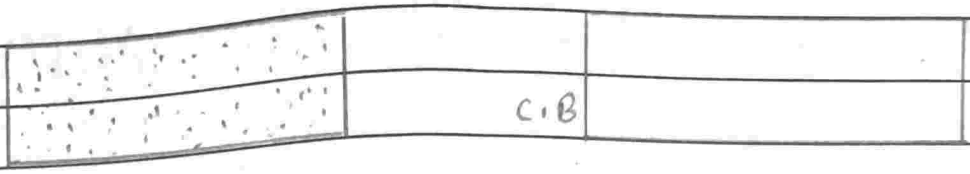
ii) In intrinsic semiconductor the valence band is completely filled & the conduction band completely empty.

7

iii) Example –

Pure Si, Pure Ga.

iv) Intrinsic semiconductor is at 0K.



(fig(c) valence band & conduction band in intrinsic semiconductor at 0 K.)

* Extrinsic semiconductor -

Dopping - Adding impurities in a pure substance is called dopping.

Extrinsic Semiconductor is 2 types -

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

(a) n-type semiconductor -

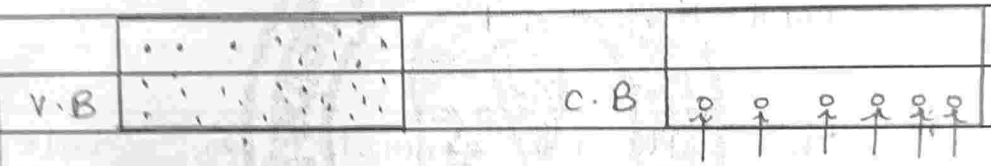
i) The semiconductor in which pentavalent impurity is added is called a n-type semiconductor.

ii) At 0 K valence band is completely filled with e^- & conduction band is completely empty.

iii) For adding impurity temperature is increase upto 50K-100K the

electrons in valence band is excited towards the conduction band, there is some empty space in valence band is called holes.

iv) As similar there is large no. of unoccupied space in conduction band.



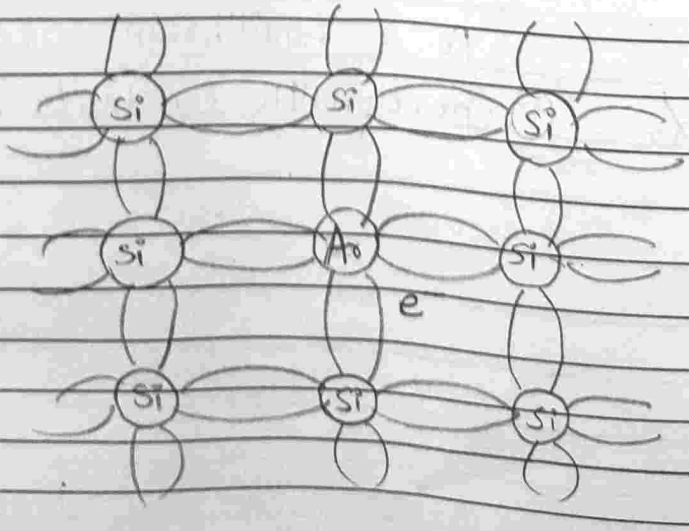
(fig (d) V.B & C.B transition of $\bar{e}$ at 50 - 100 K)

v) In intrinsic semiconductor at 0 K the $n_e = P_h$

where,

n_e = no. of electrons

P = no. of holes



(b) P-type semiconductor -

i) The semiconductor in which trivalent impurity is added is called P-type semiconductor.

ii) At Room temperature, the electrons in valence band excited towards conduction band.

iii) The rate of generation = rate of recombination

The rate of recombination r_i is directly proportional to $n_o p_o$

i.e

$$r_i \propto n_o p_o$$

$$r_i = \alpha_r n_o p_o$$

where,

n_o = equilibrium of electrons

p_o = equilibrium of Holes

α_r = Proportionality constant.

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SUPPLIMENT

Signature of Supervisor	

Suppliment No. :

Roll No. : 1338

Class :

Subject : Semiconductor

Test / Tutorial No. : Internal.

Div. :

17/20

Q. 1

1] 10^{23}.

2] insulator

3] decreases

4] 2.16

5] $\frac{1}{1 + e^{E-E_f/KT}}$

Q. 2

1]

Direct and Indirect Semiconductor.

From Bloch Theorem.

The periodicity of periodic table material are define by schodinger eqn

$$\left[\frac{-\hbar}{2m}\nabla^2 + V(x)\right]\psi_x = E\psi_x$$

So plane wave eqn

$$\psi U_x = E\psi_x$$

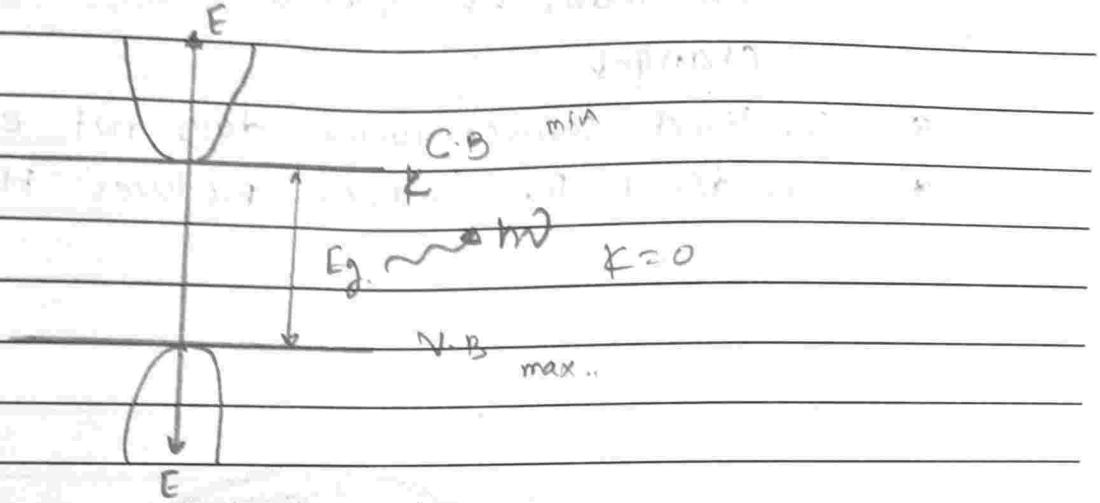
U_x is the modulator electronic lattice periodicity changes

The From E-K curve, the lattice are periodicity is same and E-V changes when material changes their lattice periodicity it means K value change with change Band structure.

There are Two types of semiconducters.

① Direct semiconducter.
② Indirect semiconducter.

① Direct semiconductor.



In direct semiconductor material, minimum of conduction Band. to maximum of valence. band. the K-value is zero.

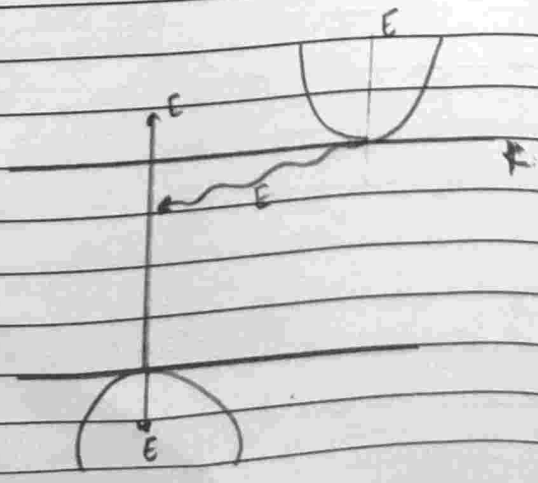
Direct semiconductor material having a minimum band gap.

Uses in LED (Light Emitting Diode)

Used in LASR.

Direct semiconductor material it emits the radiation. uses material, GaAs, InP, InAs, ZnS.

② InDirect semiconductor



* In - Indirected semiconducter material, minimum of conduction band and to maximum of Valence Band. The K- value changes
* Indirect semiconducter does not emit radiation.
* Indirect semiconducter produces Heat