Vivekanand College, Kolhapur. (Autonomous)
Department of Physics
Internal Examination Notice
2021-22

Date: 10 May 2022

~~2022~~

All students of class B.Sc. I, B.Sc. II and B.Sc. III are hereby noticed that the second term internal evaluation examination is scheduled as per following time table.

Nature of question paper:

For B.Sc. I : Long answer question (Any two from given four questions) for 20 marks

Short answer question (Any four from given six questions) for 20 marks

For B.Sc. II : Long answer question (Any one from given two questions) for 10 marks

Short answer question (Any two from given four questions) for 10 marks

For B.Sc. II (Astro) : Long answer question (Any one from given two questions) for 10 marks

Short answer question (Any two from given four questions) for 10 marks

Internal Evaluation Examination 2021-22.
SEM II, SEM IV and SEM VI
Time Table

Sr. No.	Class	Paper	Date	Time
1.	B.Sc. I	Paper II	22/05/2022	11:00 am to 12:30 pm
2.	B.Sc. II	Paper IV	22/05/2022	11:00 am to 12:00 pm
3.	B.Sc. II (Astrophysics)	Paper II	25/05/2022	04:00 pm to 05:00 pm

HOD

VIVEKANAND COLLEGE ESTD JUNE 1964 KOLHAPUR - 416003

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

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur

(Autonomous)

Department of Physics

Internal exam (2021-22)

B.Sc.III Sem VI

Attendance Sheet

Roll No.	Name Of Student	Signature			
		14/01/2022	14/01/2022	15/01/2022	15/01/2022
7751	Bam Shruti Harish	Bam	Bam	Bam	Bam
7752	Bhatmare Shivani Sanjay	Shivani	Shivani	Shivani	Shivani
7753	Chauhan Aditi Brijesh	Chavan	Chavan	Chavan	Chavan
7754	Dhamanekar Deepa Anil	Deepa	Deepa	Deepa	Deepa
7755	Dharaniya Jitendra Govindram	JP	JP	JP	JP
7756	Dhumale Swapnil Sahebrao	Dhumale	Dhumale	Dhumale	Dhumale
7757	Gove Vaishnavi Shashikant	Gove	Gove	Gove	Gove
7758	Gudami Shrinivas Mallappa	SG	SG	SG	SG
7759	Inamdar Ruturaj Sharad	Ruturaj	Ruturaj	Ruturaj	Ruturaj
7760	Kamble Abhishek Pandurang	Akamble	Akamble	Akamble	Akamble
7761	Khekare Kallesh Chandrakant	KCK	KCK	KCK	KCK
7762	Kumbhar Gaurav Dinkar	Gaurav	Gaurav	Gaurav	Gaurav
7763	More Akshada Vijay	More	More	More	More
7764	Mude Gargi Anil	GMude	GMude	GMude	GMude
7765	Naik Mitali Vijay	Mitali	Mitali	Mitali	Mitali
7766	Patil Asmita Ramesh	Patil	Patil	Patil	Patil
7767	Patil Snehal Suresh	Snehal	Snehal	Snehal	Snehal
7768	Potdar Abhishek Sharad	Potdar	Potdar	Potdar	Potdar
7769	Shirke Pranali Pradeep	Shirke	Shirke	Shirke	Shirke
7770	Singh Rohit Sanjay	RS	RS	RS	RS

Internal Examinar.......[signature]..........

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Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Autonomous)

Internal Examination 2021-22

PHYSICS-DSC -1001F1

B.Sc. – III, Sem – VI Semiconductor Devices and Instrumentation

Time: 30 Minutes Marks: 20

Q. 1. LONG Answer Questions (Any one) **(10)**

1. What is Static and Dynamic Resistance. Explain Principle, construction and working of Solar Cell

2. Discuss Current Flow Mechanism in Forward and Reverse Biased Diode.

Q. 2. SHORT Answer Questions (Any two) **(10)**

1. Explain the application of CRO for Study of Waveform.
2. Write a note on p and n type semiconductors.
3. Explain Barrier Formation in PN Junction Diode.

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Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT	Signature of Supervisor:
Suppliment No.: 10/20	Subject : Semiconductor & devices
Roll No. : 7765	Test / Tutorial No. :
Class : B.Sc. - III	Div. :

Q1.

1. principle -

A. Solar cell is electronic device that Converts light energy into electrical energy through photovoltaic effect. A Solar cell is basically p-n junction diode.

* Solar Cell Construction -

The principle layer of this cell includes an antireflection cover glass. This glass guards the Semiconductor materials against the Sunlight. In this cell, small grid patterns with slight metallic strips are available under the glass. So that the top layer of this cell can be formed by using the glass.

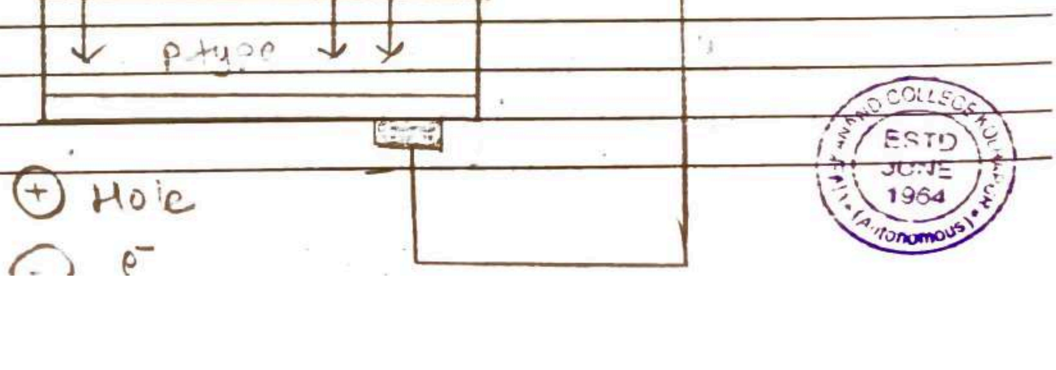
The most important part of the cell is the middle layer where Solar energy Can be formed through the effect

It Consists of two semiconductor layers which are made up of P-type and n-type materials.

The base layers of this cell consists of two parts. A rear metallic electrode is beneath, the P-type Semiconductor and it works with the metallic grid to generate and electric current in the pinnacle layer. A reflective layer, is the last layer is this cell used to decrease the loss of light within the system.

* Working -

Once the Solar energy falls on solar panel, then it absorbs, Each panel in the solar panel includes semiconductor material to Combin the properties of insulator and metal So it makes to convert the light energy into electrical. Once the energy from the Sun falls on panel then Semiconductor absorbs the energy of photons transfer to electrons and allows flow of electrons as through the material like an electric current.



(10)

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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	

Suppliment No. :

Roll No. : 7768

Class : B.Sc III

Subject : Semiconductor & devices

Test / Tutorial No. : Internal exam

Div. :

18/20

Q.1

1. principle :-

A solar cell is electronic device that converts light energy into electrical energy through the photovoltaic effect. A solar cell is basically a p-n junction diode.

Solar cell construction:-

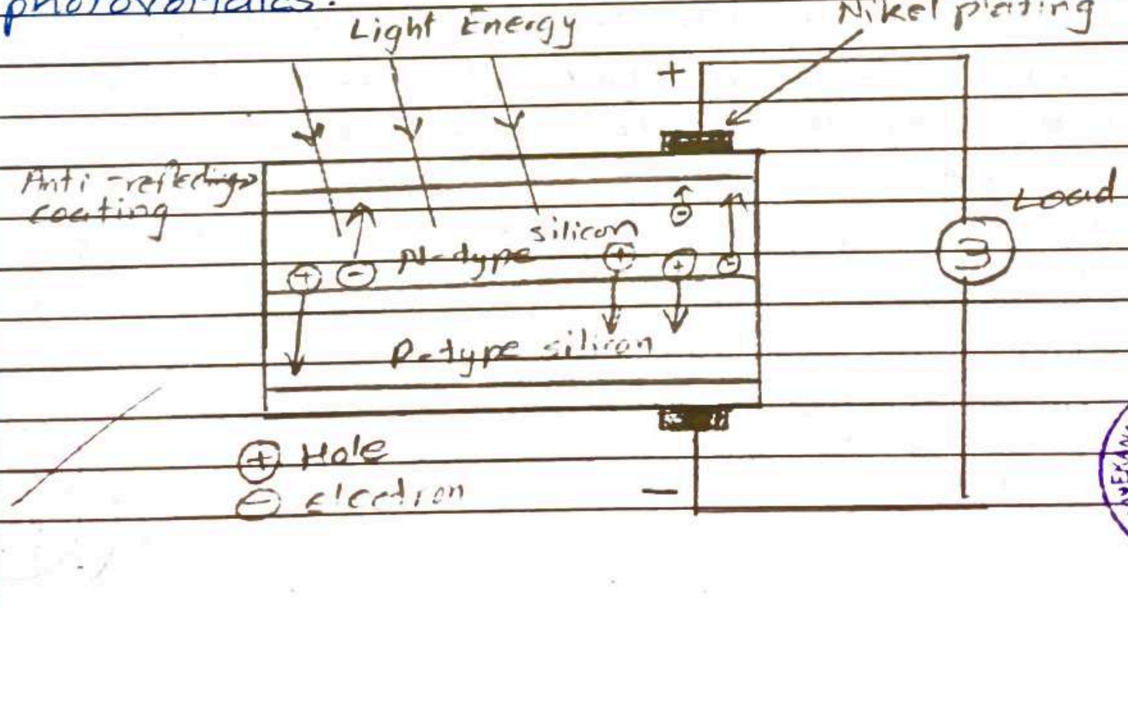
The principle layer of this cell includes an anti-reflection cover glass. This glass guards the semiconductor materials against the sunlight. In this cell, small grid patterns with slight metallic strips are available under the glass. so that the top layer of this cell can be formed by using the glass, metallic strips and anti-reflective coat.

The most important part of the cell is the middle layer where solar energy can be formed through the effect of photovoltaic. It consists of two semiconductor layers which are made up of p-type and n-type materials.

The base layer of this cell consist of two parts. A rear metallic electrode is beneath the p-type semiconductor and it works with the metallic grid to generate and electric current in the pinnacle layer. A reflective layer is the last layer is this cell used to decrease the loss of light within the system. Based on the application, solar cell utilize various materials based on their application and cost.

Working :-

Once the solar energy falls on a solar panel, then it absorbs. Each panel in the solar panel includes semiconductor material to combine the properties of insulators and metal. so it makes to convert the light energy into electrical. once the energy from the sun falls on the panel then a semiconductor absorbs, the energy of photons transfers to electrons and allows the flow of electrons through the material like an electric current. There are different kinds of semiconductor materials used in solar cells like silicon, photo-voltaics like Thin-film, organic and concentration photovoltaics.



Q.2 2) P type semiconductor :-

1. A p-type semiconductor is an intrinsic semiconductor doped with boron or indium.

2. The majority of carriers in p-type semiconductors are holes.

3. Electrons are minority carriers in a p-type semiconductor.

4. In a p-type semiconductor, the hole density is much greater than the electron density.

5. The acceptor energy level of the p-type is close to the valency bond and away from the conduction band.

6. In an n-type semiconductor an intrinsic semiconductor doped with phosphorus or antimony as impurity.

3) N-type semiconductor:-

1. The majority of charge carries in n-type semiconductors are electrons.

2. Holes are minority carriers in a n type semiconductor

3. In the n type of semiconductor, the electron density is much greater than the hole density.

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Vivekanand College, Kolhapur (Autonomous)

Internal Examination 2021-22

PHYSICS-DSC -1001F1

B.Sc. – III, Sem – VI Elements of Modern Physics

Time: 30 Minutes | Marks: 20

Q. 1. LONG Answer Questions (Any one) **(10)**

1. Write explanation of anomalous Zeeman effect on Vector atom model.
2. Explain anomalous Zeeman Effect and obtain an expression for term shift.

Q. 2. SHORT Answer Questions (Any two) **(10)**

1. Write a note stark effect in Hydrogen.
2. Write a note second order stark effect.
3. Compare strong field and weak field stark effects.

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Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

13/20

Signature of Supervisor	

Suppliment No. :

Subject : Elements of modern physics

Roll No. : 7753

Test / Tutorial No. : Internal exam

Class : B.Sc III

Div. :

Q.1

1 Anomolous Zeeman effect :-

Using high resolving power instrument and weak magnetic fields, it was found that each spectral line splits into several components. This effect is known as anomalous Zeeman effect.

By introducing the concept of spining electron and Lande's vector model, a semiclassical model was developed which explains the observed Zeman patterns quite satisfactorily. When there is no field or when the magnetic field is weak, electron-spin and orbital motions are coupled i.e. the orbital angular momentum $l^* \frac{h}{2\pi}$ and spin angular momentum $s^* \frac{h}{2\pi}$ precess

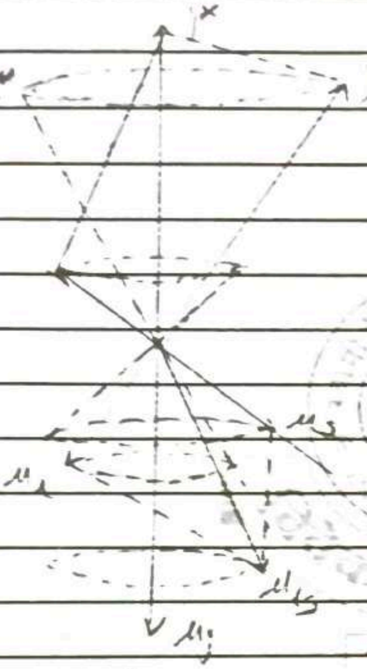
with same period about their resultant angular momentum $j^* \frac{h}{2\pi}$ as shown in fig.

It should be noted that the completely filled core of the atom and hence we need consider only the contribution of valence

According to classical theory the magnetic moment due to orbital motion of electron is,

$\mu_l = I A$, where $I = \frac{e}{T}$ is current in the orbit,
and

$A = \int_0^{2\pi} \frac{1}{2} r^2 d\theta$, is area of the orbit.



But orbital angular momentum $p_l = mr^2 \frac{d\theta}{dt}$ is conserved

$$\therefore A = \int_0^T \frac{1}{2} \frac{p_l}{m} dt = \frac{1}{2} \frac{p_l}{m} T$$

$$\therefore \mu_l = \frac{e}{T} \cdot \frac{1}{2} \frac{p_l}{m} \cdot T = p_l \frac{e}{2m}$$

where $p_l = l^* \frac{h}{2\pi}$ according to quantum mechanics

and $\qquad l^* = \sqrt{l(l+1)}$

Using quantum mechanics Dirac showed that, the magnetic moment due to spining electron is,

$$\mu_s = p_s \cdot 2 \cdot \frac{e}{2m}$$

Q. 2

1. Stark in 1913, observed that the Balmer series lines of hydrogen split into a number of components when excited by electric fields of about 10^5 V/cm. The first satisfactor theoretical explanation for stark effect was given by Epstein and others using quantum mechanics. The results of the theory show that the term shift ΔT i.e. shift in energy levels from the respective field-free states is given by,

$$\Delta T = AF + BF^2 + CF^3 + \cdots \quad (1)$$

where,

F is strength of applied electric field and A, B, C..... are constants.

$$A = \frac{3h}{8\pi^2 mec} \cdot n (n_2 - n_1)$$

$$= 6.42 \times 10^5 \cdot n (n_2 - n_1)$$

05

$$\& \; B = \frac{h^5}{2^{10}\pi^6 m^3 e^6 c} \cdot n^4 \{17n^2 - 3(n_2 - n_1) - 9m_1^2 + 19\}$$

$$= 5.22 \times 10^{-16} \cdot n^4 \{17n^2 - 3(n_2 - n_1) - 9m_1^2 + 19\} \quad (2)$$

The first term in eq^n (1) involving F is first order stark effect while second term involving F^2 is called second order stark effect.

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Vivekanand College, Kolhapur (Autonomous)

Internal Examination 2021-22

PHYSICS-DSC -1001F2

B.Sc. – III, Sem – VI Solid State Physics I

Time: 30 Minutes Marks: 20

Q. 1. LONG Answer Questions (Any one) **(10)**

1. Examples of crystal structure NaCl and KCL.
2. Explain Laue diffraction method - Principle, Construction, Working and Application.

Q. 2. SHORT Answer Questions (Any two) **(10)**

1. Derive an expression Bragg's law in reciprocal lattice.
2. What are the types of X-ray diffraction methods.
3. Write a note on Rotating crystal method of x-ray diffraction.

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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Suppliment No. :	15/20	Signature of Supervisor	
Roll No.	: 7760	Subject	: Solid State Physics-I
Class	: B Sc-III, Sem-VI	Test / Tutorial No. :	
		Div. :	

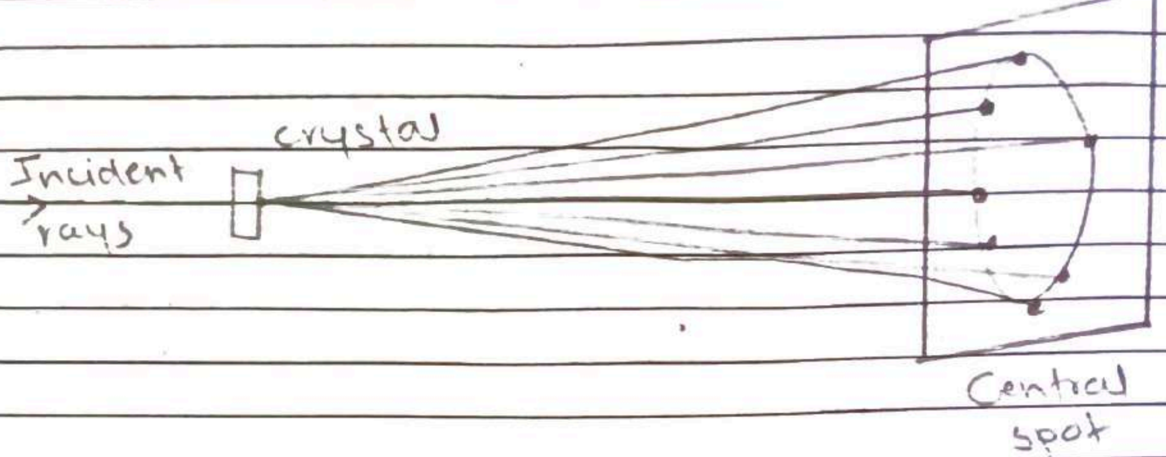
Q 1)

2) Laue method →

The principle of this method the beam falls upon a small crystal or thin crystal section and the diffracted beams are recorded on a photographic plate placed at a distance of a few centimeters from the crystal. The rays are limited to a narrow pencil by the slit system the crystal is set on aholder which permits adjustment of its orientation and the photographic plate is placed in the other holder.

A beam with continous range of wavelength is obtained by using a bulb with tungsten anticathode and a high tension of about 65,000 volt. This potential is insufficient to excite the characteristics x-radiation of tungsten, the presence of which would confuse the record and the available ranges of white radiation extends from 2 to 1 Å.

In this case the Laue photograph, the various crystal planes reflect the x-Rays as if they constitude a number of mirrors set up at different angles. The relation $n\lambda = 2d\sin\theta$ can be satisfied.



The angle θ is fixed for each set of planes because radiation of appropriate wavelength can be selected from the continuous range. When a Laue photograph is taken with the rays parallel to an important axis of the crystal, it will be noticed that the circular area in the centre is free of spots. As their inclination to the axis is made smaller, both θ and λ decreases in the equation $n\lambda = 2d \sin\theta$ until a point is reached where λ is less than the short wave limit of the continuous spectrum, reflection is then impossible.

The deduction of the crystal structure from the appearence of Laue photograph is complicated process because the intensities of the spots do not depend on the structure alone.

Q-2)

2) The Bragg's law $n\lambda = 2d \sin\theta$ for X-Ray diffraction that θ and λ be matched; that is X-Rays of wavelength λ stricking a crystal at an arbitary angle of incidence in general will not be reflected. To satisfy Bragg's low it is necessary to provide experimentally for a continuous range of values λ or θ. The standard methods are

1) Laue method →

A single crystal is held stationary in a beam of continuous wavelength X Ray diffraction The crystal Selects out and diffracts the discrete values of λ for which planes of spacing d exist and incidence angle θ satisfies the Bragg's law.

2) Rotating crystal method →

A single crystal is rotated about the fixed axis in a beam of monochromatic x-rays. The variation in θ brings different atomic planes into position for reflection.

5

3) Powdered method →

A powdered sample of crystalline material is placed in a fixed position in a monochromatic beam. During the distribution of the crystalline orientations there may be some for which the angle of incidence satisfies the Bragg's law.

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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor:

Suppliment No. :

20/20

Subject : Solid state physics - II

Roll No. : 7768

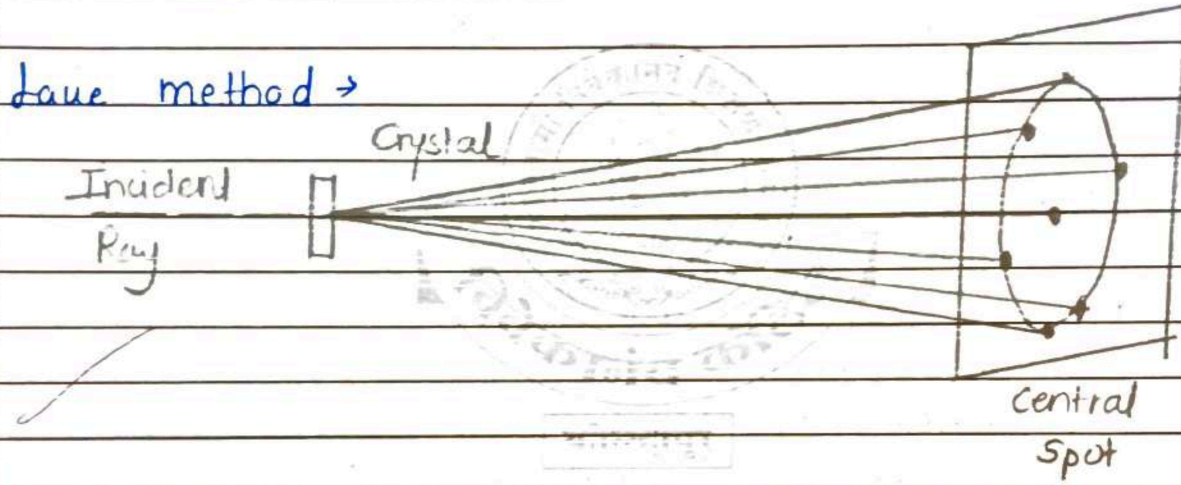
Test / Tutorial No. :

Class : B.Sc-III, Sem-VI

Div. :

Q 1)

2) Laue method →



The principle of this method the beam falls upon a small crystal / thin crystal section and the diffracted beams are recorded on a photographic plate placed at distance of a few centimeters from the crystal. The rays are limited to narrow pencil by the slit system the crystal is set on holder which permits adjustment of its orientation and the photographic plate is placed in other holder.

A beam with continuous range of wavelength is obtained by using a bulb with tungsten anticathode and a high tension of about 65000 volt. This potential is insufficient to excite the characteris k- radiation of tungsten, the presence of which would confuse the record and the available ranges of white radiation extends from 2 to 1 A°

In this case the Laue photograph the various crystal planes reflect the x-rays as if they constitute a number of mirrors set up at different angles. The relation $\gamma\lambda = 2d \sin\theta$ can be satisfied

The angle θ is fixed for each set of planes because, radiation of appropriate wavelength can be selected from the continuous range. when Laue photograph is taken with the rays parallel to an important axis of the crystal, it will be noticed spots. As their inclination to the axis is made smaller both θ and λ decreases in the eqn $n\lambda = 2d\sin\theta$ until a point is reached λ is less than the short wave limit of the continuous spectrum, reflection is then impossible the deduction of crystal structure from the appearence of Laue photograph is complicated process because the intension of the spot.

10

Q2.

2. The Bragg's Law $n\lambda = 2d\sin\theta$ for X-ray diffraction that θ and λ be matched that is X rays of wavelength λ striking a crystal at an arbitotry angle of incidence in general will not be reflected, To satisfy Bragg's law it is necessary to provide experimentally for Continuous range of values λ or θ the standard methods are.

1) Laue method -

A Single crystal is held stationary in beam of continuous wavelength X-ray diffraction the crystal select out and diffracts the discrete Values of λ for which planes of Spacing d exist values of λ for which and incidence angle θ Satisfies the Bragg's Law.

2) Rotating Crystal method -

A Single crystal is rotated about the fixed axis in beam of monochromatic X-rays The Variation in θ brings different atomic planes into position for reflection

5

3) Powdered method -

A powdered Sample of Crystalline material is placed in a Fixed position in a monochromatic beam. During the distribution of the Crystalline Orientation there may be same for which the angle of incidence Satisfies the bragg's Law.

Q2.

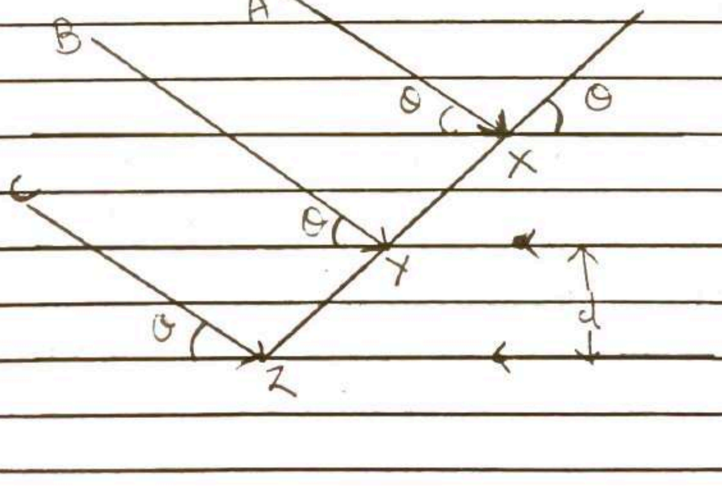
1. Bragg's Law - In 1913 Bragg's law was 1st proposed by Sir William Bragg's and his son Sir Lawrence Bragg. they Studied about the diffraction of x-ray of x-ray and derived a method for determining the wavelength of x-ray.

Statement -

when x-ray is incident onto a crystal surface its angle of incidence will reflect back with same angle of scattering. And when the path difference is equal to whole number n, of wavelength a constrictive interference will occur

$$n\lambda = 2d\sin\theta$$

λ = Wavelength of x-ray
d = path difference
θ = Incidence angle
n = An integer ($n = 1, 2, 3 \ldots$)



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Vivekanand College, Kolhapur (Autonomous)

Internal Examination 2021-22

PHYSICS-DSC -1001F2

B.Sc. – III, Sem – VI Solid State Physics II

Time: 30 Minutes | Marks: 20

Q. 1. LONG Answer Questions (Any one) **(10)**

i) Discuss Kronig- Penney model of metal

ii)Describe with suitable diagram the powder method for determination of crystal structure.

Q. 2. SHORT Answer Questions (Any two) **(10)**

i) Explain how solids are classified on the basis of energy band gap.

ii) Distinguish between n-type semiconductor and p-type semiconductors.

iii) Obtain the relation between direct lattice and reciprocal lattice.

VIVEKANAND COLLEGE KOLHAPUR ESTD JUNE 1964 (Autonomous)

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Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

20/20

Suppliment No. :

Subject : Solid State Physics II

Roll No. : 7769

Test / Tutorial No. :

Class : B.Sc-III , Sem VI

Div. :

Q.2)

2)

N - type Semiconductor :-

1) It is an extrinsic semiconductor which is obtained by doping impurity pentavalent impurity atoms, such an antimony.

2) The impurity atoms added provide extra electrons in the structure and are called donor atoms.

3) The electrons are majority charge carriers and holes are minority charge carriers.

5

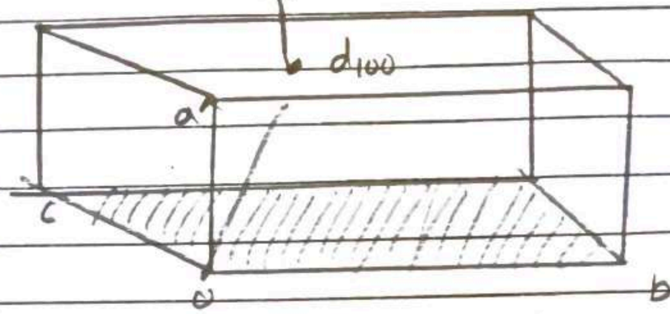
P - type Semiconductor :-

1) It is an extrinsic semiconductor which is obtained by doping trivalent impurity atoms such as boron, gallium, indium.

2) The impurity atoms added create vacancies of electrons in the structure.

3) The holes are majority charge carrier and electrons are minority charge carrier.

3) The relation between direct and reciprocal lattices can be derived by deriving the relation between the normal to the plane and the crystallographic axes a, b, & c. The height of this cell is d_{100} = OR.



The volume of unit cells = V = (area of shaded region) × height
= V = (area) · (OR)

The area of the shaded base can be written by vector algebra as $\bar{A} = \bar{b} \times \bar{c}$ and the volume of unit cell $V = \bar{a} \cdot [\bar{b} \times \bar{c}]$.
The height OR is the spacing of the bc planes = d_{100}

$$\therefore V = A \cdot OR$$

$$V = A \cdot d_{100}$$

or $$\frac{1}{d_{100}} = \frac{A}{V} \quad \text{—— (1)}$$

$$\frac{\vec{n}}{d_{100}} = \frac{\bar{b} \times \bar{c}}{\bar{a} \cdot [\bar{b} \times \bar{c}]} \quad (2)$$

where, $\bar{n}$ is unit vector normal to the shaded area

$$\therefore |\bar{a}^*| = |\bar{d}^*_{100}| = \frac{M}{d_{100}} \quad \text{—— (3)}$$

$$\therefore \bar{a}^* = \bar{d}^*_{100} = M \cdot \frac{\vec{n}}{d_{100}} \quad \text{—— (4)}$$

or $$\bar{d}^*_{100} = \vec{a}^* = M \cdot \frac{\vec{b} \times \vec{c}}{\bar{a} \cdot [\bar{b} \times \bar{c}]} \quad \text{—— (5)}$$

In a similar way we can deduce

$$\bar{d}^*_{100} = \bar{b}^* = M \cdot \frac{\bar{c} \times \bar{a}}{\bar{a} \cdot [\bar{b} \times \bar{c}]} \quad \text{←—— (6)}$$

$$\vec{d}^{*}_{001} = \vec{c} = M. \frac{\bar{a} \times \bar{b}}{\bar{a} \cdot [\bar{b} \times \bar{c}]} \quad \text{--- (7)}$$

Equations (5) (6) & (7) give the reciprocal lattice vectors in terms of the direct lattice vectors

Q. 1>

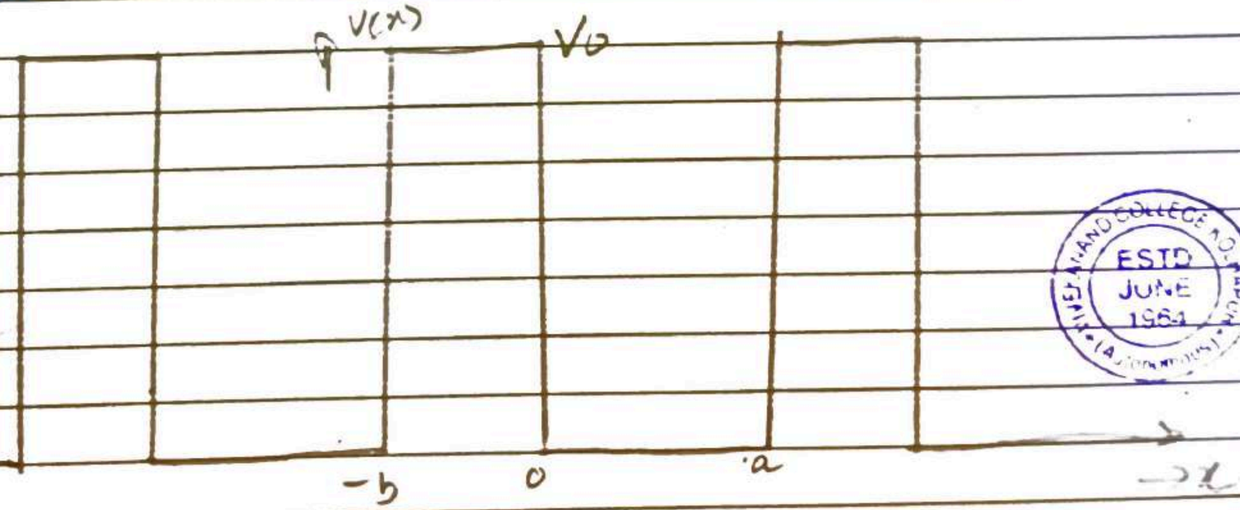
1> In this model of crystal, it is assumed that the atomic nuclei are fixed at their proper crystal positions in periodic way in the nuclei are fixed at their proper crystal positions in periodic way lattice due to interaction between the electron and nucleus potential energy V of an electron is negative.

In one dimensional Kronig-penney model of crystal the P.E. of an electron is represented as being a series of square wells.

The schrödinger equation for two region are

$$\therefore \frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2} E\psi = 0 \quad \text{for} \quad 0 < x < a \quad , V(x) = 0 \quad \text{--- (1)}$$

$$\text{and} \quad \frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2} (E - V_0)\psi = 0 \quad , \text{for} \quad -b < x < 0 \quad V(x) = V_0 \quad \text{--- (2)}$$



One dimensional kronig- penney model of crystal

Let us assume that electron is bounded in potential well i.e. the energy of electron E is less than height of potential well V_0 . $E < V_0$

$$\alpha^2 = \frac{2mE}{\hbar^2} \quad \& \quad \beta^2 = \frac{2m[V_0 - E]}{\hbar^2} \qquad \because (V_0 - E) \text{ is +ve}$$

where α and β are real quantities. The eq^n ① & ② become,

$$\frac{d^2\psi}{dx^2} + \alpha^2\psi = 0 \quad \text{for } 0 < x < a$$

$$\frac{d^2\psi}{dx^2} - \beta^2\psi = 0 \quad \text{for } -b < x < a.$$

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

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Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT 15/20

Signature of Supervisor	

Suppliment No. :

Roll No. : 7770

Class : B.Sc-III, Sem VI

Subject : Solid state physics II

Test / Tutorial No. :

Div. :

Q1.

1. Discuss Kronig-penney model of metal

⇒ In this model of crystal, it is assumed that the atomic nuclei are fixed at their proper crystal positions in periodic way in the nuclei are fixed at their proper crystal positions in periodic way lattice due to interaction between the electron and nucleus, potential energy V of an e^- is negative

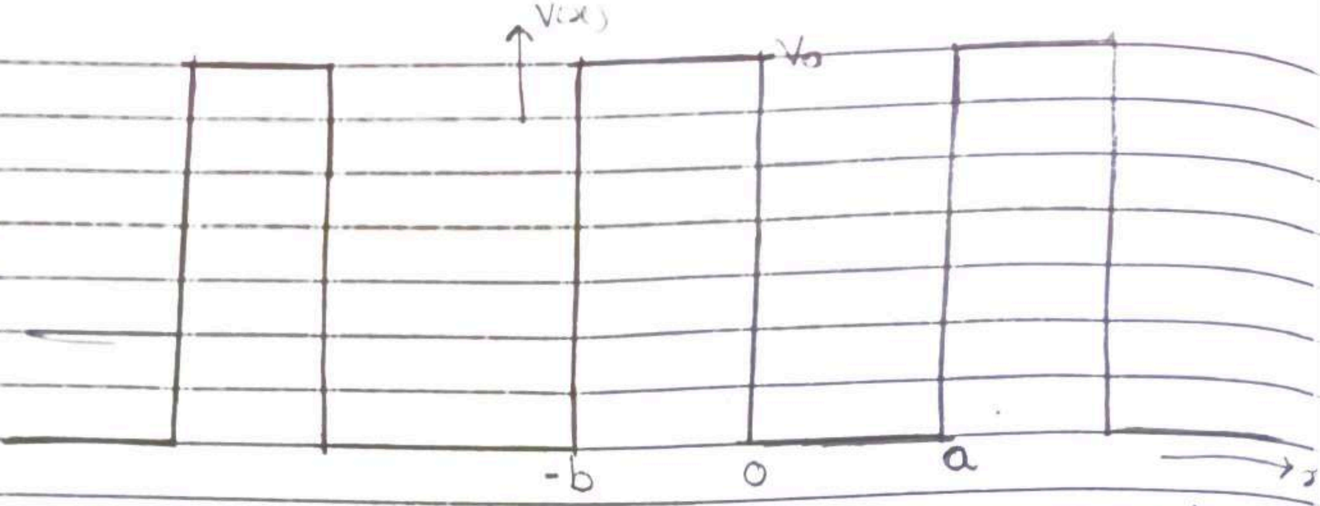
In one-Dimensional kronig-penney model of crystal the P.E of an e^- is represented as being a Series of Square wells.

The Schroedinger Eq^n for two region are

$$\therefore \frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2} . E\psi = 0 \quad \text{for } 0 < x < a, \quad V(x) = 0 \quad -(1)$$

$$\text{and } \frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E - V_0)\psi = 0, \quad \text{for } -b < x < 0$$

$$\because V(x) = V_0 \quad -$$



One-dimensional kronig-penney model of Crystal

Let us assume that e^- is bounded in potential well i.e the energy of electron E is less than height of potential well V_0 $E < V_0$

$$\alpha^2 = \frac{2mE}{\hbar^2} \quad \& \quad \beta^2 = \frac{2m[V_0 - E]}{\hbar^2} \quad \ldots \; \because (V_0 - E) \text{ is } +ve \quad \text{--- (3)}$$

where α & β are real quantities. The eq^n (1) and (2) become,

$$\therefore \frac{d^2\psi}{dx^2} + \alpha^2\psi = 0 \quad \text{for} \quad 0 < x < a$$

$$\therefore \frac{d^2\psi}{dx^2} - \beta^2\psi = 0 \quad \text{for} \quad -b < x < 0$$

Q2.
ii. Distinguish betn n-type Semiconductor and P-type Semiconductor

→

N- type Semiconductor -

1> It is an extrinsic Semiconductor which is obtained by doping impurity pentavalent impurity atoms, Such as Antimony

2> The impurity atoms added provide extra, electrons in the structure and are called donor atoms

3> The electrons are majority charge Carriers and holes are minority charge Carriers.

P- type Semiconductor -

1> It is an extrinsic Semiconductor which is obtained by doping trivalent impurity atoms such as boron, gallium, indium

2> The impurity atoms added, create Vacancies of electrons in the structure

3> The holes are majority charge carriers and electrons are minority charge carriers