Tribhuvan University

Institute of Science and Technology

2080

✡

Bachelor Level / First Year/ First Semester/ Science | Full Marks: 60

Computer Science and Information Technology (PHY. 113) | Pass Marks: 24

(Physics) | Time: 3 hours.

(OLD COURSE)

Candidates are required to give their answers in their own words as for as practicable.

The questions are of equal value.

Section A

Long Answer Questions.

Attempt any TWO questions. [2×10=20]

1. What do you mean by the *pn* (*p* and *n* refers to hole and free electrons) junction? Use Fermi-Dirac statistics and Maxwell-Boltzmann distribution to show the flow of electrons from *n* to *p* is equal to the flow from *p* to *n*. Discuss the mobility of holes and electrons in the *pn* junction. [10]

2. Set up differential equation for an oscillation of a spring using Hooke's and Newton's second law. Find the general solution of this equation and hence the expressions for period, velocity and acceleration of oscillation. [10]

3. Describe Frank Hertz experiment. Why do we need to heat up the mercury in Franck-Hertz experiment? How does temperature affect the Franck-Hertz experiment? Interpret the result of the experiment. [10]

Section B

Short Answer Questions. [8×5=40]

Attempt any EIGHT questions.

4. Discuss magnetic dipole moment. What is its effect on atom? and on molecules? Explain. [5]

5. Explain the process of semiconductor purification by describing the zone refining and single crystal growth. [5]

6. Explain the construction and working of TTL gate. [5]

7. You are spinning a 5 kg solid ball with a radius of 0.50 m. If it is accelerating at 4.0 radian/s^2, what torque are you applying? [5]

8. An electron is placed midway between two fixed charges, q_1= 2x10^{-10} C and q_2= 6x10^{-10} C. If the charges are 1 m apart, what is the velocity of the electron when it reaches a point 10 cm from q_2? [5]

9. What is the wavelength of an electron moving at 5.31 x 10^6 m/sec? [Given: mass of electron = 9.11 x 10^{-31} kg and h = 6.626 x 10^{-34} Js.] [5]

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10. What is the probability of finding a particle in a well of width a at a position $a/2$ from the wall if n = 1, 2, and 3. The normalized wavefunction is $\psi(x,t) = \left(\frac{2}{a}\right)^{\frac{1}{2}} sin\left(\frac{n\pi x}{a}\right) e^{-\frac{iEt}{\hbar}}$ [5]

11. Sodium metal crystallizes in the bcc structure with an edge length of unit cell 4.29×10^{-8} cm. Calculate the atomic radius of sodium metal. [5]

12. The output of a digital circuit (y) is given by this expression:

$$y = (BD + \bar{C}A)(\overline{BA})$$

Where A, B, C and D represent inputs. Draw a circuit of above equation using OR, AND and NOT gate and hence find its truth table. [5]

⇒ Equilibrium current across the P-N Junction

Q.N;1

When P-N junction is formed a potential barrier i.e. v is formed that stops the flow of majority charge carrier across the Junction. At Junction equal amount of electrons and holes are continuously flowing in opposite direction so that net flow is zero. This is the equilibrium current across the P-n Junction

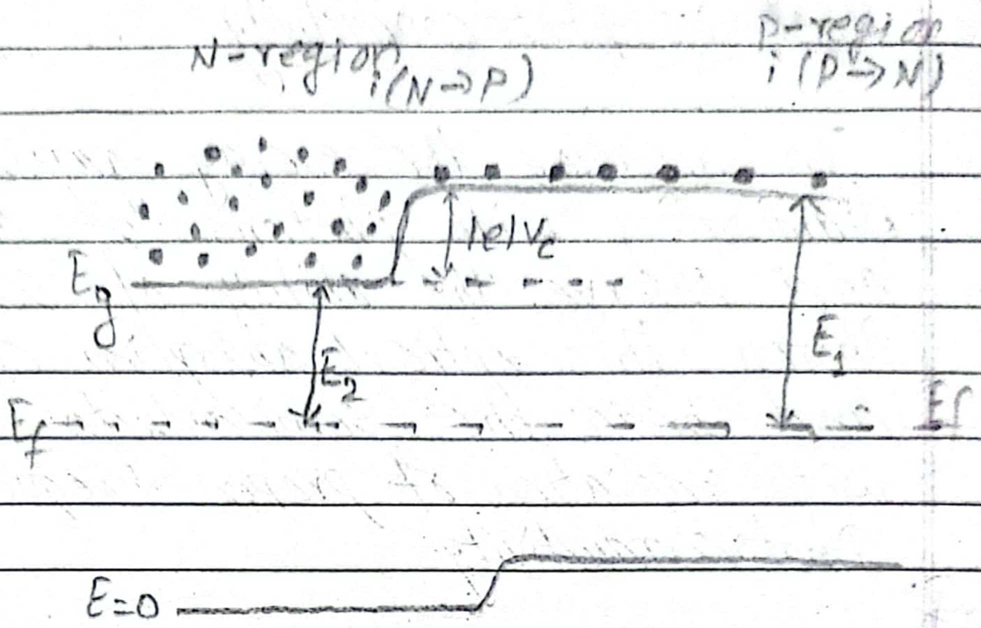

fig:- Equilibrium is established

Here, we consider flow of electrons in conduction band. So, N_e is given by

$$N_e = N_c \, e^{\frac{-(E_g - E_f)}{k_B T}} \quad --- \quad (1)$$

eq^n (1) gives the free electrons concentration for both types of semiconductor $E_g - E_f$ is much greater for P-types than N-types. The electron in the conduction band of P region are not impeded by the potential barrier crossing the junction from P-side. So, N-side electron current from P to N is $i(P \to N)$. We can write this

$$i(P \to N) = A e^{\frac{-E_1}{k_B T}} \quad --- \quad (2)$$

where A is constant "$E_1 = E_g - E_f$"

The electron current $i(N \to P)$ will be proportional to the no. of electrons in the N-region with energies greater than or equal to V_c

i.e $i(N \to P) = A N_e f(E \geq |e|V_c)$ --- (3)

where, N_e is the total numbers of electrons in the conduction band of N-side of $f(E \geq |e|V_c)$ is the fraction of these electrons with energies greater than or equal to $|e|V_c$. The Fermi Dirac distribution can be approximated by the Maxwell Boltzmann distribution. The system of ~~pra~~ particles having Maxwell Boltzmann distribution of energies the function of particles with energies greater than or equal to E_1 is $e^{-\left(\frac{E_1}{k_B T}\right)}$

we have relations

$$F(E \geq |e|V_c) = e^{-\frac{|e|V_c}{k_B T}} \quad \text{--- (4)}$$

putting the value of $N_e = e^{-\left(\frac{E_c - E_g}{k_B T}\right)}$ and

$F(E \geq |e|V_c)$ in eq^n (3) we get,

$$i(N \to P) = A e^{\frac{-E_2 + |e|V_c}{k_B T}} \quad \text{--- (5)}$$

where, $E_2 = E_g - E_f$ in N region

we have relation $E_2 + |e|V_c = E_1$

So eq^n ⑤ become

$$i(N \to P) = A\, e^{\frac{-E_1}{k_B T}} \quad \text{----} \quad (6)$$

From eq^n (2) and (6)

$$i(N \to P) = i(P \to N) \quad \text{---} \quad (7)$$

Therefore the flow of electron from N to P is equal to P to N. Thus Net current is zero. This is the condition of equilibrium current across the P-N junction.

Net Flow of charge carries across the P-N Junction

When an external voltage V is applied across the diode in the Forward bias, the height of the potential barrier at P-N junction is $|e|(V_0 - V)$. The net electron current from N-side to P-side is

$$i = i(N \to P) - i(P \to N) \quad \text{----} \quad (8)$$

The first term represents the flow of electrons from (N to P) Height of barrier is $|e|(V_0 - V)$ so we can write

$$i(N \to P) = A\, e^{\frac{-E_2 + |e|(V_0 - V)}{k_B T}} \quad \text{---} \quad (9)$$

we know that $i(P\to N)$ represents the flow of electrons (minority carrier) from P to N is the same.

$$i(P\to N) = A\, e^{\frac{-E_1}{k_B T}} \quad \text{---} \; (10).$$

using eq^n (10) and (9) in eq^n (8)

$$i = A\, e^{\frac{-E_2 + |e|(V_c - V)}{k_B T}} - A\, e^{\frac{-E_1}{k_B T}} \quad \text{---} \; (11)$$

we have,

$$E_2 + |e| V_c = E_1 = E_g - E_f$$

V_c = conduction band

eq^n (11) becomes

$$i = A\, e^{\frac{-(E_1 - |e|V)}{k_B T}} - A\, e^{\frac{-E_1}{k_B T}}$$

$$i = A e^{\frac{-E_1}{k_B T}} \left(e^{\frac{|e|V}{k_B T}} - 1 \right)$$

let $I_0 = A e^{\frac{-E_1}{k_B T}}$ so that

$$\boxed{I = I_0 \left(e^{\frac{|e|V}{k_B T}} - 1 \right)}$$

This equation is called diode equation

$I_0 = A e^{\frac{-E_1}{k_B T}}$ is the current associated with minority carries From P to N. which is not affected by the height of potential barrier is proved.

Q.N;2

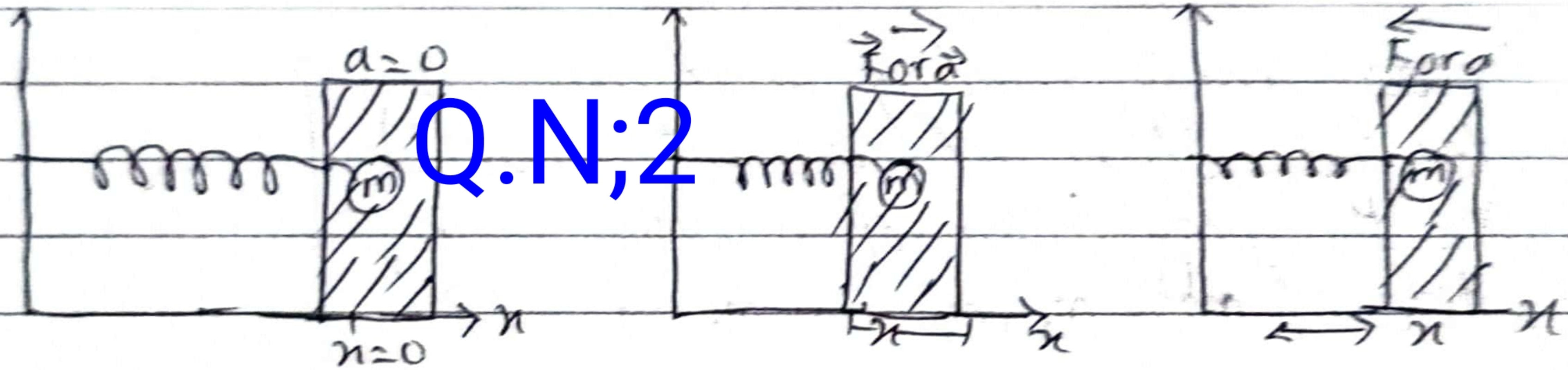

Fig :- motion of horizontal spring along x-axis

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Let m be the mass of the particle which is attached by horizontal spring. At first it is rest ($a=0$) after application of force it stretched then Force $F = kx$ --- (i) which is given by Hook's Law, where x is the stretching length. When we apply Force in one direction then there is reaction Force in another direction with the help of Newton's third Law of motion so Force becomes.

$$F = -kx \quad --- (ii)$$

where K is Force constant or spring constant

$$F = ma$$

$$F = m\frac{d^2x}{dt^2} \text{ --- (iii) (double derivative of velocity)}$$

From eq^n (ii) and (iii)

$$m\frac{d^2x}{dt^2} = -kx$$

$$\boxed{m\frac{d^2x}{dt^2} + kx = 0} \quad --- (iv)$$

which is the eq^n of horizontal spring. This eq^n is same as the eq^n of S.H.M so, it is oscillatory motion.

Solution of this equation is

$$x = A\sin(\omega t + \phi)$$

wher ϕ is the phase angle, $(\omega t + \phi)$ is phase Factor and A is Amplitude.

using relation,

$$ma = -kx$$

$$a = \frac{-k}{m}x$$

$$\therefore \boxed{\text{acceleration } (a) = \frac{-k}{m} \times x}$$

Again, From acceleration of oscillatory motion

$$a = -\omega^2 x$$

$$\cancel{+}\frac{k}{m} \times \cancel{x} = \cancel{+}\omega^2 \cancel{x}$$

$$\omega = \sqrt{\frac{k}{m}}$$

$$\therefore \boxed{\text{angular velocity } (\omega) = \sqrt{\frac{k}{m}}}$$

$$\boxed{\text{velocity} = \sqrt{\frac{k}{m}} \times x} \quad (v = \omega r)$$

Time Period,

$$T = \frac{2\pi}{\omega}$$

The time taken by particle to complete a cycle of oscillation is called time Period 'T'.

$$\text{or, } T = \frac{2\pi}{\sqrt{\frac{k}{m}}}$$

$$\therefore \boxed{T = 2\pi\sqrt{\frac{m}{k}}}$$

Frequency,

$$F = \frac{1}{T}$$

The number of complete oscillations made by an ocillating particle in one second is called frequency. It is given by $F = \frac{1}{T}$

$$\text{or, } F = \frac{1}{2\pi\sqrt{\frac{m}{k}}}$$

$$\therefore \boxed{F = \frac{1}{2\pi}\sqrt{\frac{k}{m}}}$$

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Franck-Hertz Experiment Q.N;3

Q.N State Franck-Hertz Experiment and Explain his experiment.

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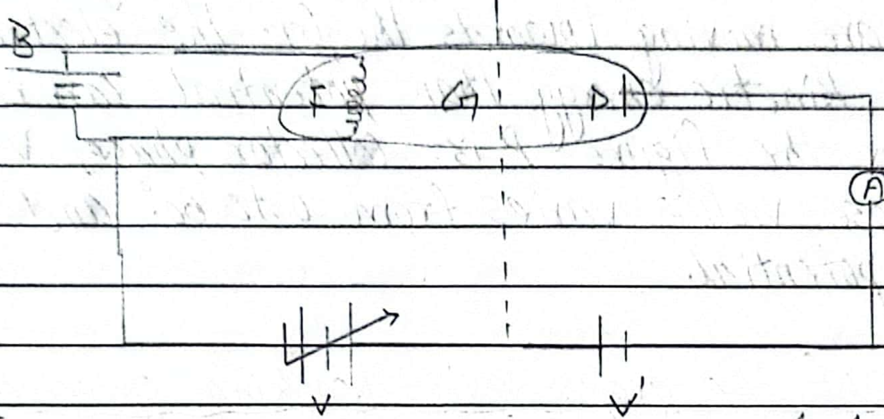

Fig(i):- Experimental arrangement of franck-Hertz experim

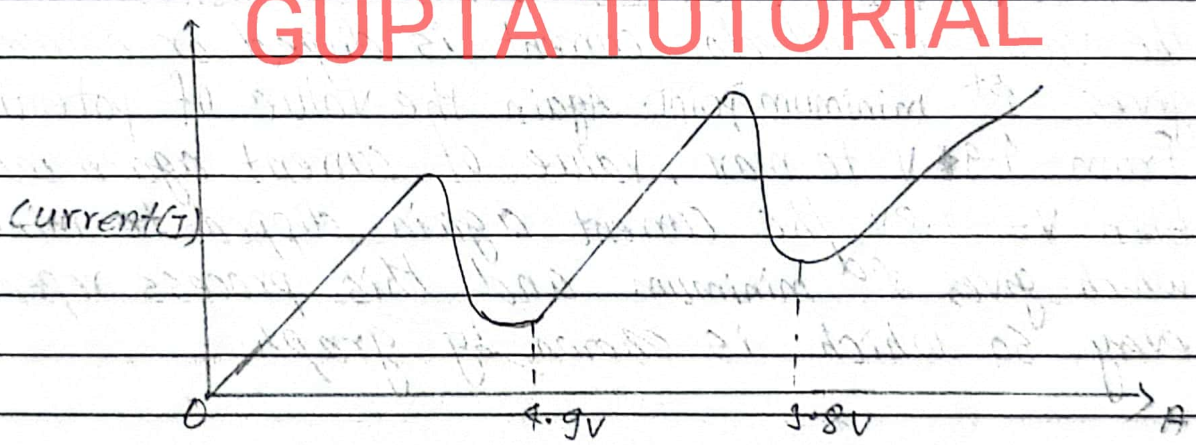

fig:(ii) Accelerating potential V

Statement :-

He proved that the existence of discrete energy state is as atom and studied the Ionization and excitation of mercury, Helium and Neon atom. He found that the discrete energy states of atoms are quantised in nature.

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Explaination

The experiment arrangement of franck - Hertz Experiment is as shown in above figure① . Gas is filled in the mercury Table. Electrons are produced by a Filament F which are moving towards the G1. The electrons which have greater kinetic energy than potential can reach from G1 to P. In the figure P is collector phase, V is variable potential whose value varies from 0 to 60° and V' is the fixed potential.

Explaination of the graph and working principle:

When the value of potential increases from 0 to other value, ~~the~~ value of current also increase. At V= 4.9V the value of collector current is dipped or decreases. It gives 1^{st} minimum point. Again the value of potential increase from 4.9V to max, value of current again increases. When V= 9.8V the current again dipped to minimum which gives 2^{nd} minimum and this process repeated every so which is shown by graph.

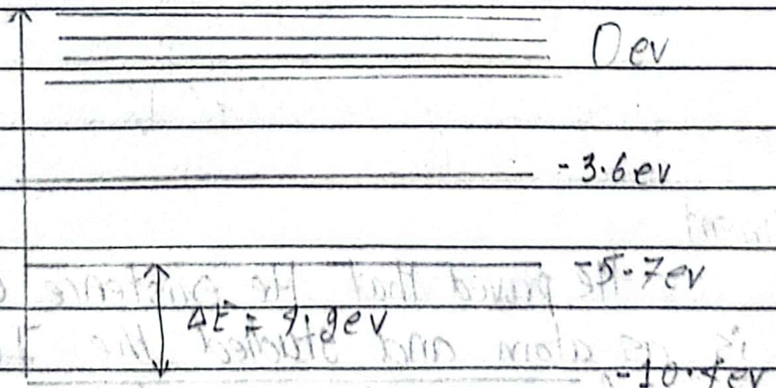

Fig: ③ Atomic energy levels of mercury atom

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Let electrons are going from G to P. At that time electrons gets energy. At V=4.9V, the electrons acquires 4.9ev energy. It looses this energy when strike with mercury atom with inelastic collision. At ~~to~~ that the current decreases and give minimum value. This suggest that the current is not becomes 0 which means some electrons can reache the plate P without loss of energy. After this minimum point the electron again moves and starts to reach to the plate. The value of potential increases and value of current also increase. The value of potential V=9.8V the current dipped and gives 2nd minimum point the electron again strike with the mercury atom of Inelastic collision. At that situation, the atom gets energy 4.9ev and emit photon in energy collision. The wavelength of the photon coming from the tube is 2536A° which is found by Franck Hertz on his experiment. Hence we can find the energy of Photon.

$$E = \frac{hc}{\lambda} = \frac{(6.67 \times 10^{-34} \times 3 \times 10^{8})}{(2536 \times 10^{-10})} = 4.9ev$$

The leaving energy of electron when strike with mercury atom is same as the energy of photon found by the experiment. This shows that the existance of discrete energy states is as atom is proved.

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Q.N;4

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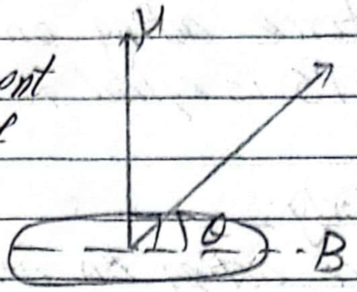
Magnetic dipole moment

The magnetic dipole moment (μ) is defined as the product of the current through the loop and area of the loop which is given by



$$\mu = IA$$

The torque acting on the loop due to magnetic field intensity (B) is

$$\tau = BIA\sin\theta$$

$$\tau = \mu B\sin\theta \quad (\mu = IA)$$

The energy of the dipole is defined as the work done in changing its orientation from 90° to θ° is

$$E = \int_{90}^{\theta} \tau\, d\theta$$

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$$E = \int_{90}^{\theta} \mu B\sin\theta\, d\theta$$

$$E = -\mu B\left[\cos\theta\right]_{90^\circ}^{\theta}$$

$$\boxed{E = -\mu B\cos\theta}$$

$$\boxed{E = -\vec{\mu}\cdot\vec{B}}$$ in vector form

Semiconductor Purification: Zone Refining

Silicon and Germanium are two of the most widely used semiconductor materials. Out of these two, Si has wide spread use because of various favorable factors associated with the material.

Q.N;5

- ⇒ It is most abundant element after oxygen in the earth. About 27.6 % of the earth's crest is made up of silicon.
- ⇒ The raw material from which pure silicon is extracted is found every where in nature. So it is very cheap.
- ⇒ There are effective and economical crystallization methods for silicon.
- ⇒ It is easy for doping by impurities.
- ⇒ Silicon oxide is used as an excellent insulator, building layer in the MOS devices.
- ⇒ Silicon has efficient response to solar radiation and light.
- ⇒ Silicon has relatively high dielectric strength and therefore suitable for power devices.
- ⇒ It is non toxic. So no special care is needed when using Si for industrial and commercial applications.
- ⇒ The energy gap of silicon is moderate leading to small leakage current.

Silicon is generally obtained from the chemical decomposition of compounds such as SiO_2, $SiHCl_3$ and $SiCl_4$. By means of different chemical reaction the Si is chemically prepared with impurity concentration of about one part per million. The chemically purified silicon is then melted and cast into ingots. The resulting ingot is polycrystalline in nature, that is, it consists of a large number of small single crystals having random orientation with respect to one another. The required purity level in Si is achieved by a method known as zone refining discovered by the scientist William Gardner Pfann. Zone refining works on the principle that "the impurities have higher solubility in the melt as compared to that in the solid. In this process, an impure Si-ingot is taken. The rod is placed in a tubular zone refiner. Inside the refiner, an inert gas environment is maintained. A series of circular mobile heating coils are placed along the rod. The heater moves along the rod from one end to the another. At a time the heater melts the particular zone of the rod along with the impurity present there. As the heater moves, the molten part of previous zone get solidified again. During solidification, the impurity of the previous zone move to newly heated zone. In other words, as the heater shifted from one zone to another the impurity also shift to the succeeding molten zone of the ingot. By the time heater reaches to the other end of impure rod, the impurity get collected there. As the impurity prefer to remain in the melt thus could be swept to the other end of the rod. This process is repeated again and again till high purity is obtained. The other end with concentrated impurity is then cut and removed.

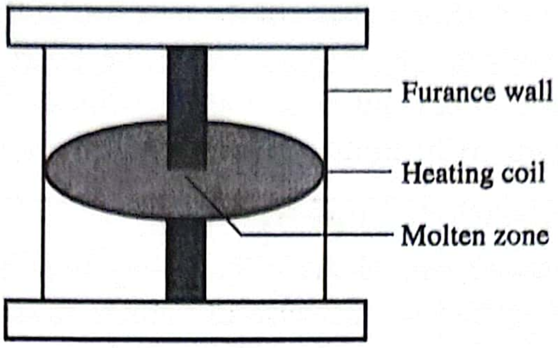

Figure: Zone Refining.

The Single Crystal Growth

To obtain the device grade silicon single crystals, the impurity concentration must be reduced. For this, the polycrystalline ingots must be transformed into the large single crystals. Nowadays, highly sophisticated IC's can be produced at reasonable cost because the methods for growing large single crystals of Si have been developed in the last few decades. Some of the methods used for single crystal growth are discussed below.

1. The Czochralski Method

The Czochralsky process is a method of crystal growth used to obtain single crystal of semiconductors. A Silicon wafer is a thin piece of semiconductor material which is used in fabrication process in integrated circuits. The following is the summary of steps in Czochralski process of Silicon wafer manufacturing.

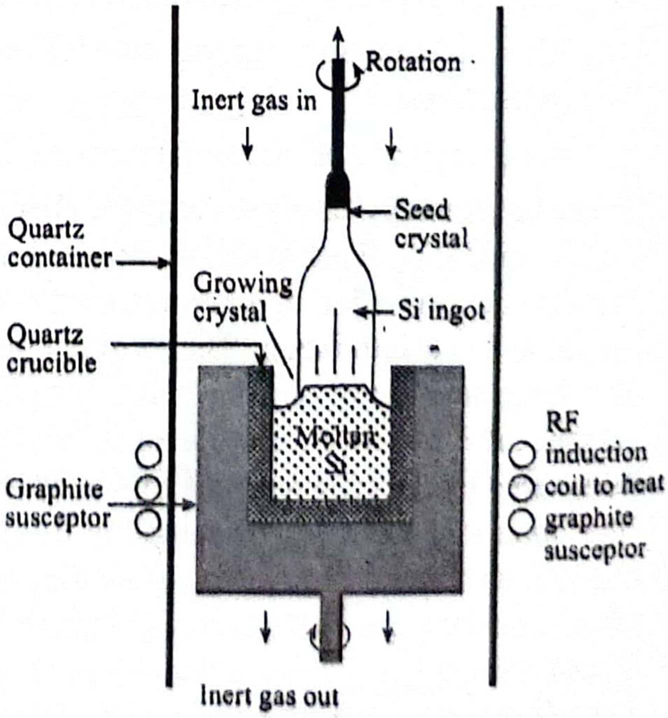

Figure: Single crystal growth by Czochralski method

a. Preparation of high purity of molten silicon

In this process high purity of silicon is encouraged to be used as molten form to form the single crystal Silicon. SiO_2 can be used to prepare high purity molten Silicon. Then the substance will be heated to its melting point into a crucible (pot) made of quartz. The supersaturated molten silicon will become the source of silicon wafer.

b. **Dipping the seed crystal**

A small piece of single crystal material known as seed crystal will be dipped into the saturated molten silicon solution. Seed crystal is equipment used to grow a large crystal of same material. The large crystal will grow when the seed crystal dipped into the melt will then be cooled.

c. **Pulling the seed upward**

The seed will extract from the molten silicon pool and rod will be pulled upward and rotated at the same time. During this time the rod and crucible rotated in opposite direction to minimize the effect of contraction in the melt. In manufacturing single crystal silicon, the temperature gradient, pulling rate and rotation speed influences the size of crystal. As the seed crystal is slowly raised upward, the molten silicon will solidifies as same as the seed. This is why this process is called growing which is producing a new crystal of silicon from molten silicon. The large cylindrical crystal silicon is called ingot which can be grown 300mm to 400 mm in diameter.

Logic Family, RTL and TTL Gates

In digital designs, a circuit configuration or arrangement of the circuit elements in a special manner will result in a particular logic family. Electrical characteristics of the IC will be indentical. In other words, different parameter like Noise margin, Fan In, Fan out etc. will be identical.

Different IC's belonging to the same logic families will be compatible with each other.

Digital IC gates are classified not only by their logic operation, but also by the specific logic circuit family to which it belongs. Each logic family has its own basic electronic circuit upon which more complex digital circuits and function are developed.

Different Types of Logic Gate Families

Q.N;6

RTL : Resistor transistor logic gate family

DCTL : Direct coupled transistor logic gate family

RCTL : Resistor capacitor transistor logic gate family

DTL : Diode transistor logic gate family

TTL : Transistor transistor logic gate family

IIL : Integrated injection gate family

An example of TTL gate is shown in figure, which implements a NAND function.

The input transistor Q_1 is an npn transistor with several emitters. Transistor with 8 or more input emitters are not unusual nor difficult to manufacture in IC form.

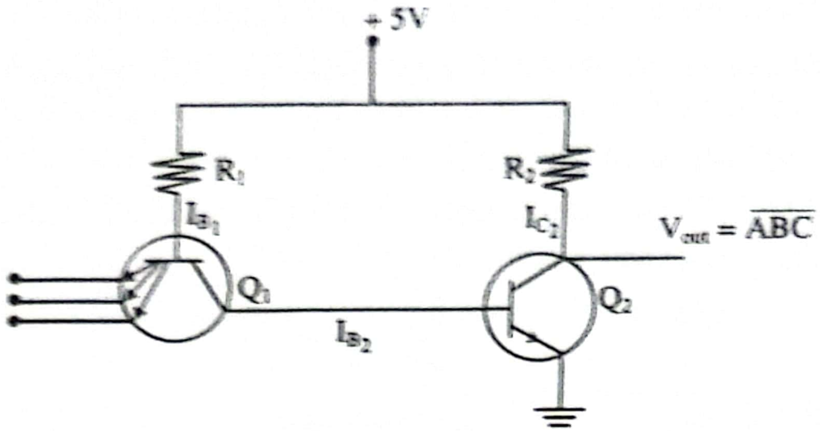

Figure: TTL gate for NAND logic function.

If any one the inputs of Q_1 is grounded (logic level 0), the base emitter junction of Q_1 will be forward based, so a large base current I_{B1} that turns Q_1 on. As a result, no current flows in the emitter base junction of Q_2. With Q_2 cutoff, its collector emitter voltage becomes 5V, that is, $V_{out} = 5V$.

Thus, if any of the inputs are at logic level 0, the output will be at logic level 1.

If all the input of Q_1 are at 5V, its base emitter will be reversed biased so no current can flow from the base of Q_1 to its emitter, current can flow through R and through the forward biased base collector of Q_1. This will turn Q_2 on and make its collector emitter voltage 0V therefore $V_{out} = 0V$.

Thus, when all inputs are at logic level 1, the output will be a logic level 0.

This is logically a NAND gate.

Fanout: It is the maximum number of inputs that can be driven by a logic gate. A fanout 10 means 10 unit loads can be driven by the gate still maintaining the output logic level.

Propagation delay: The time required for the output of a digital circuit to change states after a change at one or more of its inputs.

Noise immunity: It is the ability of a gate to stay in a given logic state in the presence of fluctuations (noise) in the input signal. A large noise immunity means output logic level will not change in the presence of large fluctuations in the input logic level.

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7. Given,

Mass of the solid ball $(m) = 5kg$

Radius of the solid ball $(r) = 0.50m$

Angular acceleration $(\alpha) = 4.0 radian/s^2$

Torque $(\tau) = ?$

As we know

Torque(τ) = Moment of Inertia(I) x Angular acceleration(α)

$\tau = mr^2 \times \alpha$

$= 5 \times (0.5)^2 \times 4$

$= 5 Nm$

$\therefore$ Torque applied is 5 Nm

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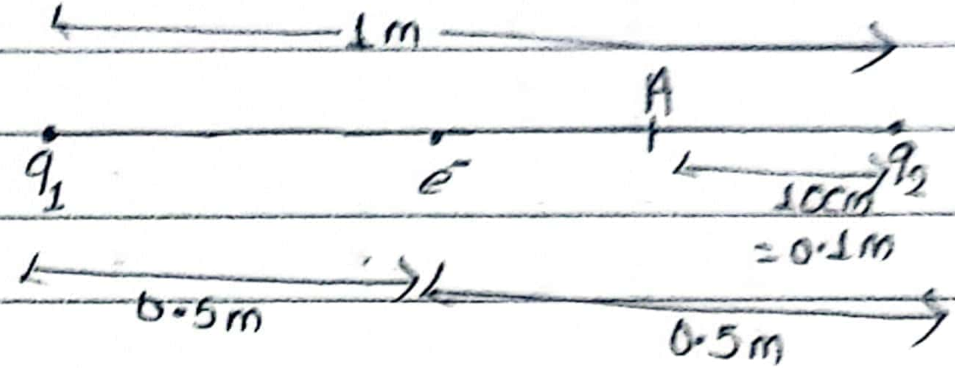
Distance travelled by electron $= 0.5 - 0.1$

$= 0.4m$



Distance between q_1 and $q_2 = 1m$

Distance between e and q_1 or e and $q_2 = 0.5m = r_1 = r_2$

Distance travelled by e^- towards q_1 from initial position

$= 0.5 - 0.1$

$= 0.4m$

Using eqn of motion

$v^2 = u^2 + 2as \quad (u = 0)$

$v = \sqrt{2as}$

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The electrostatics force between q_1 and e^- is

$$F_1 = \frac{q_1 e}{4\pi\varepsilon_0 r_1^2}$$

The electrostatics force between q_2 and e^- is

$$F_2 = \frac{q_2 e}{4\pi\varepsilon_0 r_2^2}$$

Net force

$$F = F_2 - F_1$$

$$F = \frac{e}{4\pi\varepsilon_0}\left(\frac{q_2}{r_2^2} - \frac{q_1}{r_1^2}\right)$$

$$F = 1.6\times10^{-19}\times9\times10^{9}\left(\frac{6\times10^{-10} - 2\times10^{-10}}{(0.5)^2}\right)$$

$$F = \frac{(5.76\times10^{-19})}{(0.25)}$$

$$F = 2.304\times10^{-18}\,N$$

Newton's 2nd law

$$F = ma$$

$$a = \frac{F}{m} = \frac{2.304\times10^{-18}}{9.1\times10^{-31}} = 2.531\times10^{12}\,m/s^2$$

Now,

$$\text{velocity }(v) = \sqrt{2as}$$

$$= \sqrt{2\times2.531\times10^{12}\times0.4}$$

$$= 1423198.688\,m/s$$

9 Given,

Velocity of the electron $(v) = 5.31 \times 10^{6}$ m/sec

mass of electron $(m) = 9.11 \times 10^{-31}$ kg

Planck's constant $(h) = 6.626 \times 10^{-34}$ Js.

Wavelength of an electron $(\lambda) = ?$

we know

$$\lambda = \frac{h}{P}$$

where P = momentum

$$\lambda = \frac{h}{mv} \qquad (P = mv)$$

$$= \frac{(6.626 \times 10^{-34})}{(9.11 \times 10^{-31} \times 5.31 \times 10^{6})}$$

$$\lambda = 1.3697 \times 10^{-10} m$$

$\therefore$ Wavelength of an electron is 1.3697×10^{-10} m

10. Given,

Width of wall $(l) = a$

Position $(x) = \frac{a}{2}$

Normalised wave function

$$\psi(x,t) = \sqrt{\frac{2}{a}} \cdot \sin\left(\frac{n\pi x}{a}\right) e^{\frac{-iEt}{\hbar}} \quad \text{----} (1)$$

Probability of finding the particle $P = \psi^* \psi$

$$P = \left(\sqrt{\frac{2}{a}} \sin\left(\frac{n\pi}{a} \cdot \frac{a}{2}\right) e^{\frac{+iEt}{\hbar}}\right) \cdot \left(\sqrt{\frac{2}{a}} \sin\left(\frac{n\pi}{a} \cdot \frac{a}{2}\right) e^{\frac{-iEt}{\hbar}}\right)$$

$$P = \frac{2}{a} \sin^2 \frac{n\pi}{2} \quad \text{----} (11)$$

for $n = 1$

$$P_1 = \frac{2}{a} \sin^2 \frac{\pi}{2} = \frac{2 \times 1}{a} = \frac{2}{a}$$

for $n = 2$,

$$P_2 = \frac{2}{a} \sin^2 \frac{2\pi}{2} = \frac{2 \times 0}{a} = 0$$

for $n = 3$,

$$P_3 = \frac{2}{a} \sin^2 \frac{3\pi}{2} = \frac{2}{a} \times (-1) = -\frac{2}{a}$$

Hence, the probability of finding the particle in a well of width of position $x = a/2$ from the wall for $n = 1, 2, 3$ are $\frac{2}{a}$, 0, $-\frac{2}{a}$ respectively.

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11. Given,

length of unit cell (a) = 4.29×10^{-4} cm

Atomic radius of Sodium metal (r) = ?

As we know, GUPTA TUTORIAL

BCC structure is;

$$a = \sqrt{4}\, r$$

$$\text{or, } r = \frac{a}{\sqrt{4}}$$

$$\text{or, } r = \frac{4.29 \times 10^{-4}}{2}$$

$$\therefore r = 2.145 \times 10^{-4}\ \text{cm}$$

$\therefore$ Atomic radius of Sodium metal is 2.145×10^{-4} cm Ans

12 Given expression is:

$$y = (BD + \bar{C}A)(\overline{BA})$$

Input				Intermediated state						Output
A	B	C	D	BD	$\bar{C}$	$\bar{C}A$	BA	$\overline{BA}$	$(BD+\bar{C}A)$	$Y=(BD+\bar{C}A)(\overline{BA})$
0	0	0	0	0	1	0	0	1	0	0
0	0	0	1	0	1	0	0	1	0	0
0	0	1	0	0	0	0	0	1	0	0
0	0	1	1	0	0	0	0	1	0	0
0	1	0	0	0	1	0	0	1	0	0
0	1	0	1	1	1	0	0	1	1	1
0	1	1	0	0	0	0	0	1	0	0
0	1	1	1	1	0	0	0	1	1	1
1	0	0	0	0	1	1	0	1	1	1
1	0	0	1	0	1	1	0	1	1	1
1	0	1	0	0	0	0	0	1	0	0
1	0	1	1	0	0	0	0	1	0	0
1	1	0	0	0	1	1	1	0	1	0
1	1	0	1	1	1	1	1	0	1	0
1	1	1	0	0	0	0	1	0	0	0
1	1	1	1	1	0	0	1	0	1	0

fig:- Truth table

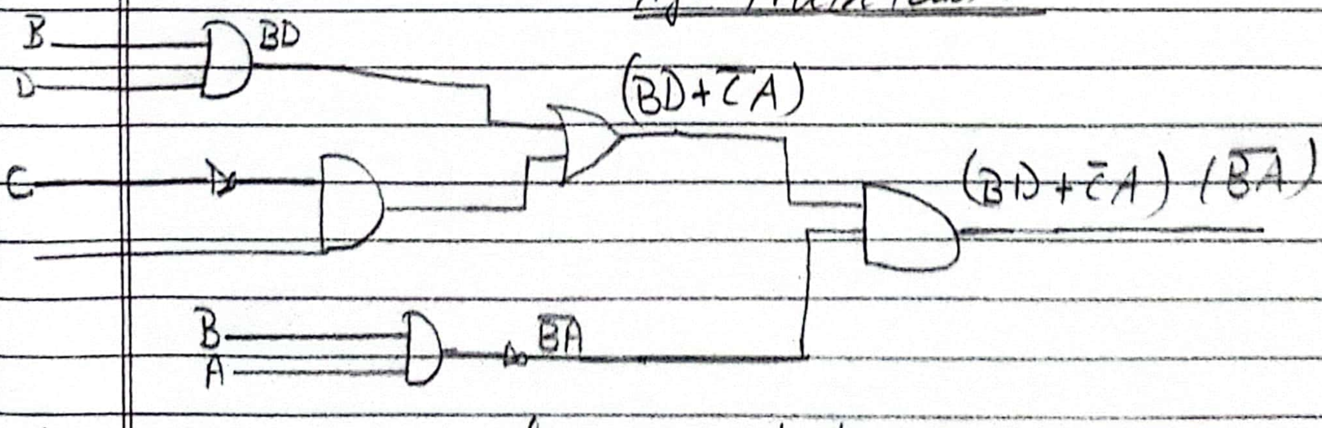

fig:- Circuit diagram