

# UNIT I (A) Hydrides Of Boron

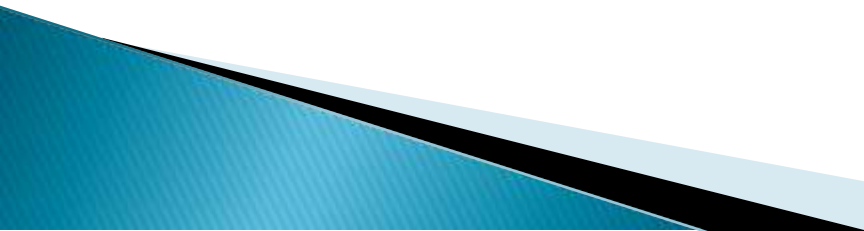
## STRUCTURE AND BONDING IN BORAZINE

Saroj Sahare

Assistant Professor

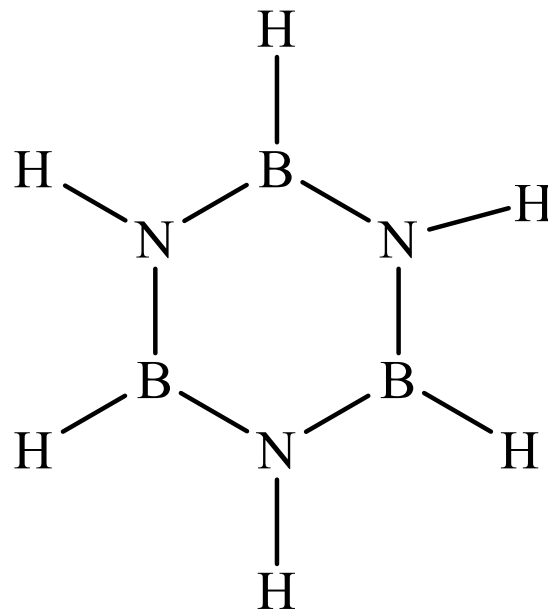
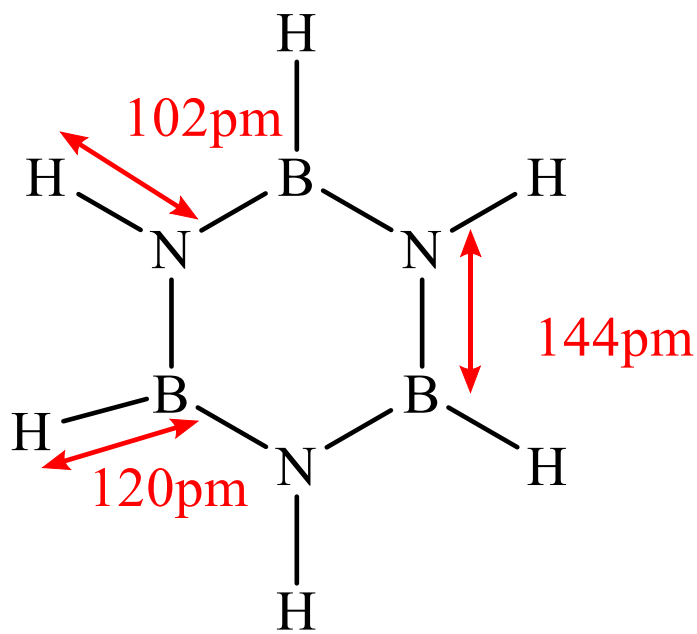
Anand Niketan College, Warora

# Borazine (Inorganic Benzene)

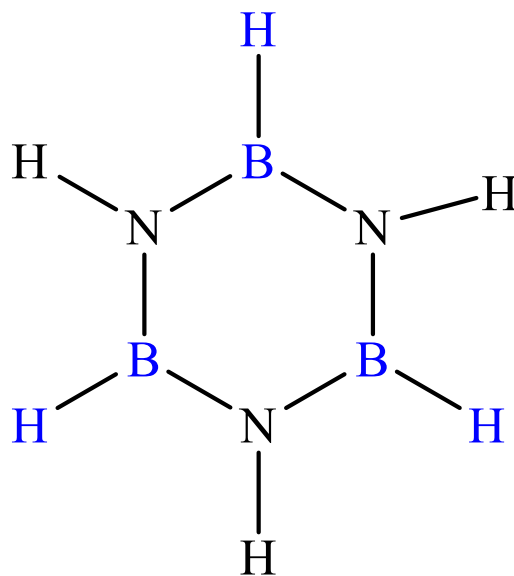
- ▶ *Formula:  $B_3H_6N_3$*
  - ▶ *Polar inorganic compound*
  - ▶ *Cyclic structure*
  - ▶ *Alternate three BH units and three NH units*
  - ▶ *Isoelectronic with Benzene*
  - ▶ *Isostructural with Benzene*
  - ▶ *Borazine is a colourless liquid*
  - ▶ *Aromatic smell*
  - ▶ *Aromatic compound*
- 

# Borazine (Inorganic Benzene)

▶ Formula:  $B_3H_6N_3$

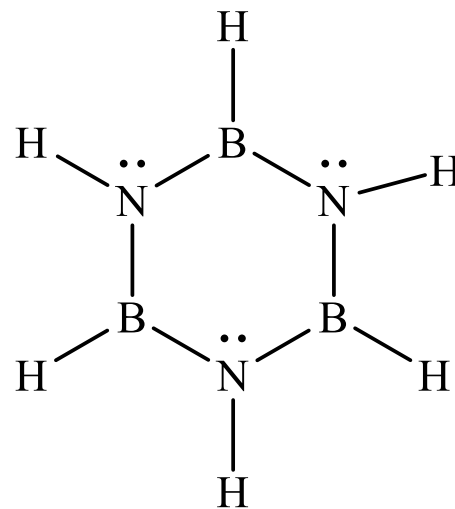
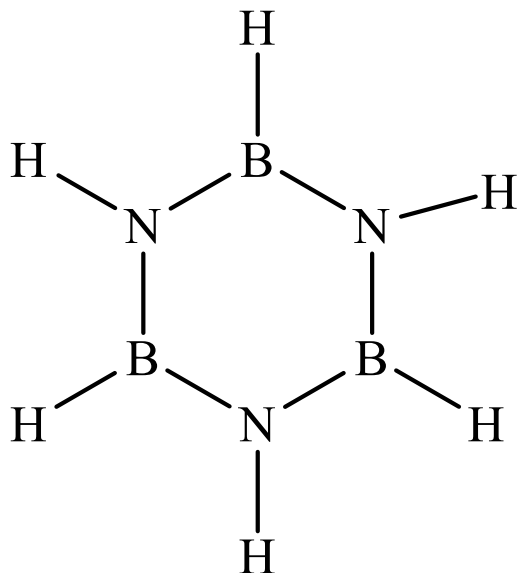


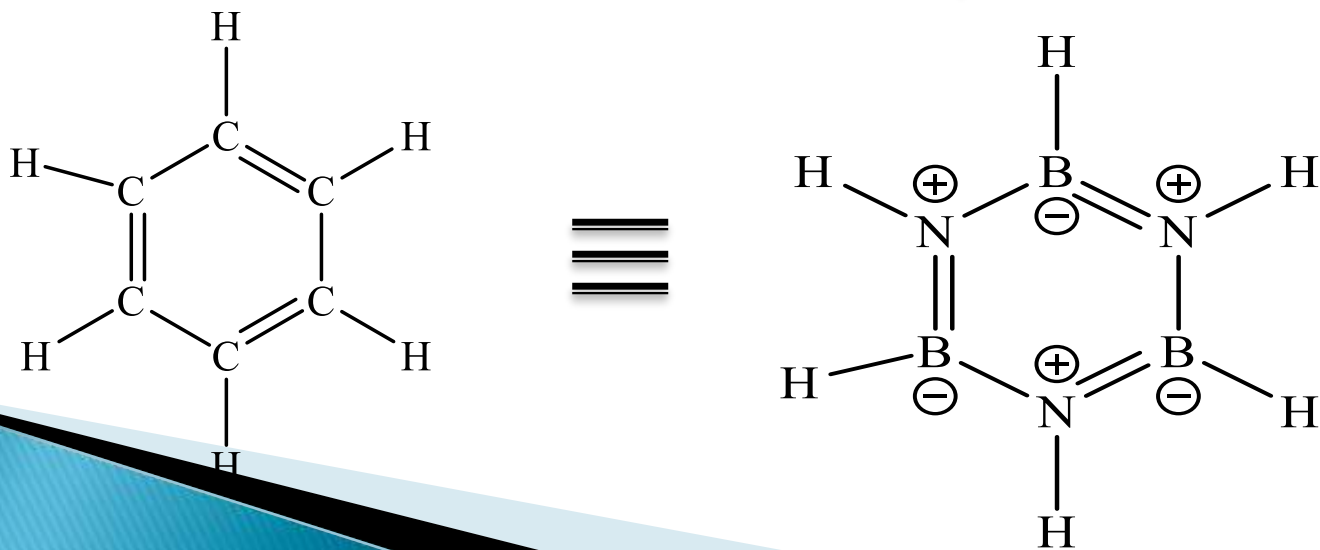
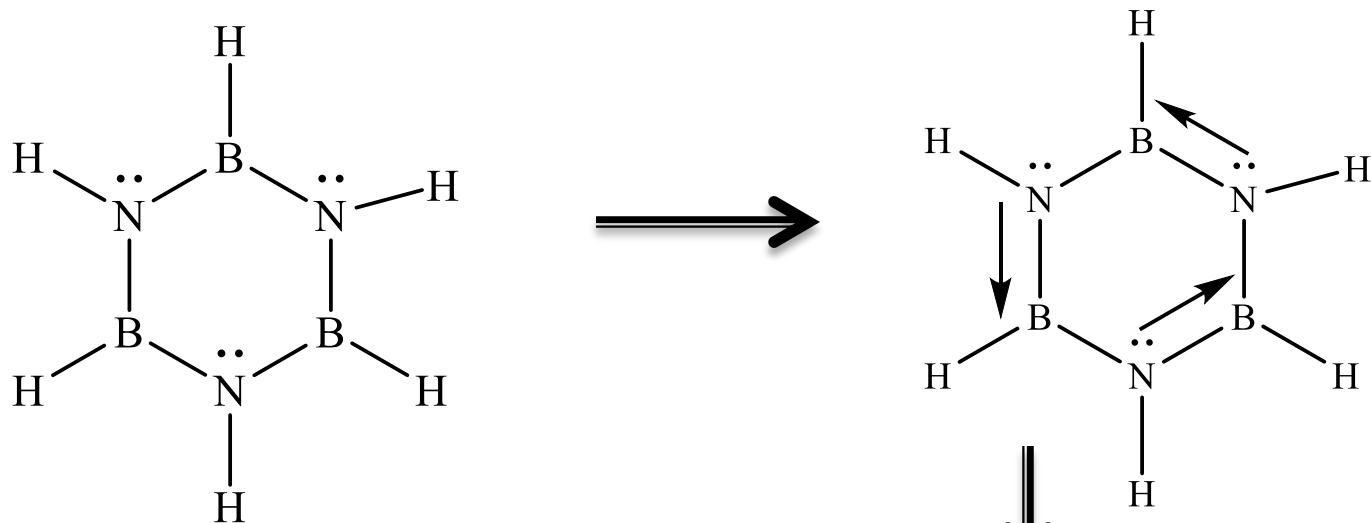
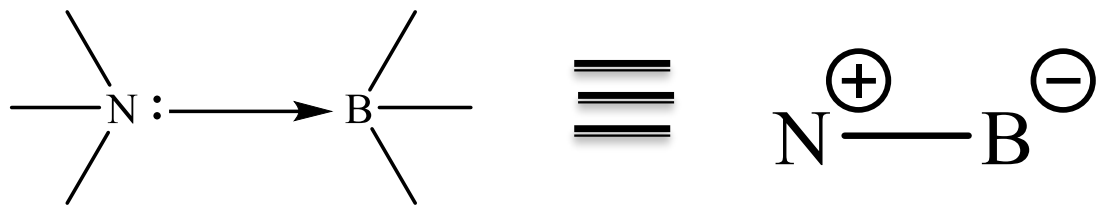
# Cyclic structure & Alternate three BH units and three NH units



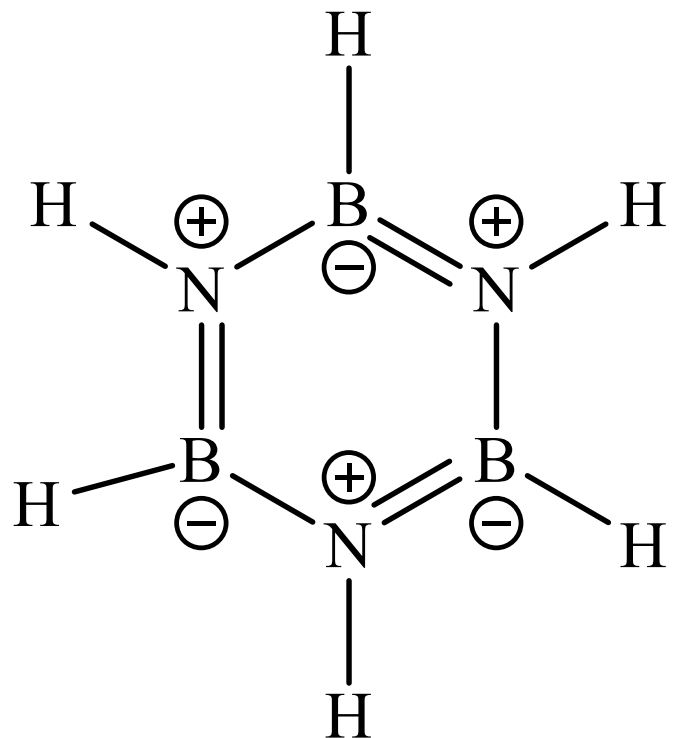


# Isostructural with Benzene



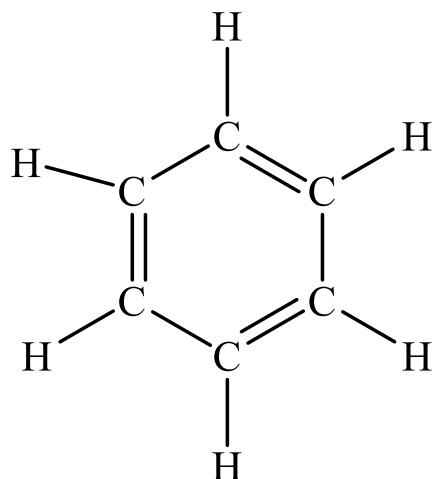


# Polar inorganic compound



# Isoelectronic with Benzene

Benzene



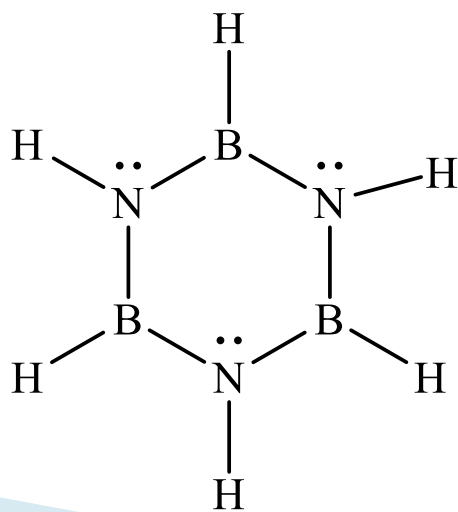
No. of electrons

$$=(C=6) \times 6 + (H=1) \times$$

6

$$= 42 e^-$$

Borazine



No. of electrons

$$=(N=7) \times 3 + (B=5) \times 3 + (H=1)$$

$\times 6$

$$= 42 e^-$$

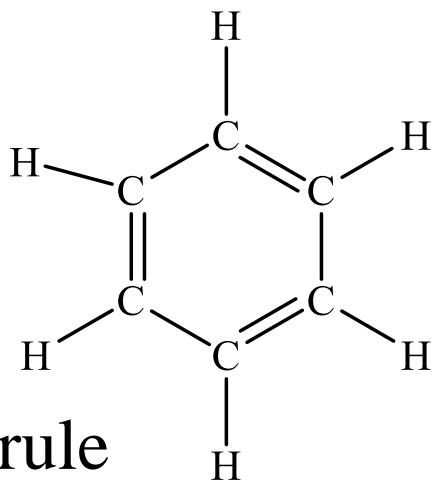
# Characteristics of Aromatic Compounds

- ▶ A delocalized conjugated  $\pi$  system
- ▶ Coplanar structure
- ▶ Cyclic nature
- ▶ A number of delocliized electrons that is  $(4n+2\pi)$  electrons this is known as Huckel rule.

# Aromatic compound

▶ Benzene

▶ Cyclic



▶ Planar

▶  $(4n+2\pi)$  rule

$\sigma$  bond = 6 (C-C) +  
6(C-H)

$\Pi$  bond = 3

$\Pi e^- = 6$

• Borazine

• Cyclic

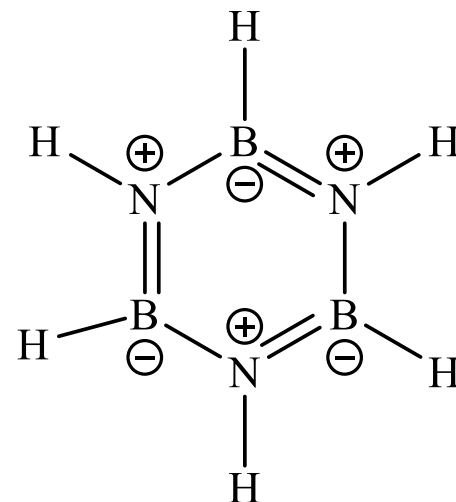
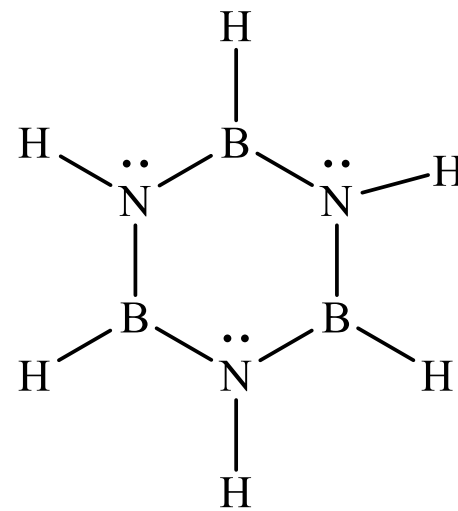
• Planar

•  $(4n+2\pi)$

$\sigma$  bond = 6 (3B-H)(3N-H)  
+ 6 (B-N)

$\Pi$  bond = 3

$\Pi e^- = 6$





**b) Atomic and ionic radii**

Defn. - it is the distance between the nucleus of an atom to the outermost shell where probability of finding an electron is maximum. it is measured in  $\text{\AA}$  or pm.

Variation of period and in a group

- 1) Atomic radius decreases in a period and increases in a group
- 2) In period - when we move from LHS to RHS i.e from IA to IIA group elements in the same period atomic radius decreases due to increase in a nuclear charge.
- 3) In Group - When we move from top to bottom in a group from Li to Fr and from Be to Ra, the atomic radius increases due to addition of extra shell
- 4) Ionic radii is also show same trend.
- 5) IA group elements have largest atomic radii in their corresponding periods.

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# B.Sc. Sem-V

## Unit-II-Magnetic Properties of Matter

Dr. Nilesh S. Ugemuge



# Syllabus-(UNIT-II -12L)

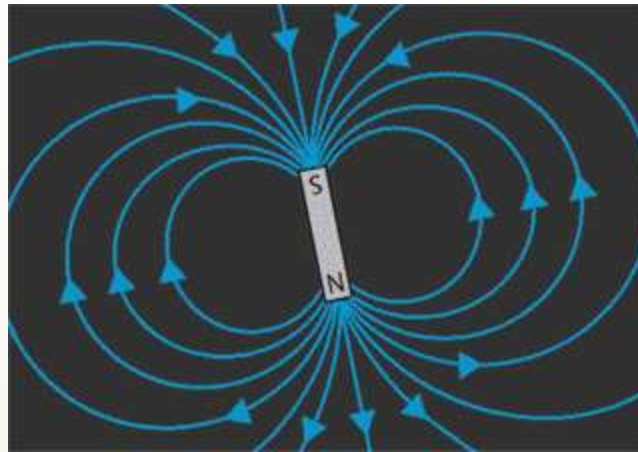
- ▶ Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials.
  - ▶ Classical Langevin theory of Dia- and Paramagnetic Domains.
  - ▶ Quantum Mechanical Treatment of Paramagnetism,
  - ▶ Curie's law,
  - ▶ Weiss's Theory of Ferromagnetism and Ferromagnetic Domains,
  - ▶ Discussion of B-H Curve, Hysteresis and Energy Loss.
- 

# Why Magnetism?



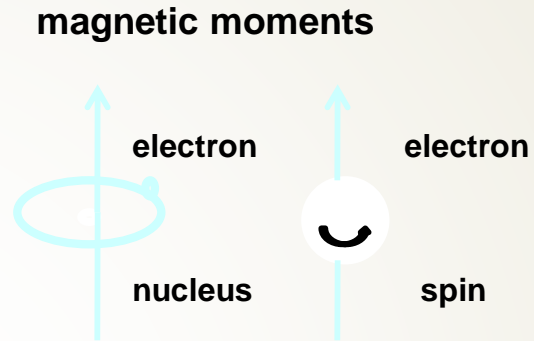
# Magnetism

- ▶ Magnetism is **the force exerted by magnets when they attract or repel each other**. Magnetism is caused by the motion of electric charges. Every substance is made up of tiny units called atoms. Each atom has electrons, particles that carry electric charges.



# Introduction(Origin of Magnetism)

- ❖ Macroscopic properties (Magnetic) are the result of electron magnetic moments.
- ❖ Moments come from 2 sources:
  - Orbital motion around a nucleus
  - Spinning around an axis



- ❖ The net magnetic moment for an atom is the sum of the magnetic moments of constituent electrons.
- ❖ Atoms with completely filled electron shells does not contribute to magnetic moment of the atom.
- ❖ The main contribution to magnetism comes fro the spin of the unpaired valence electrons.

# TYPES OF MAGNETISM

The magnetism in solids has been classified into the following groups depending upon the number of valence electrons present in the atoms of the solid and on the relative orientations of the neighboring magnetic moments :

- Diamagnetism
- Para magnetism
- Ferromagnetism
- Anti-ferromagnetism
- Ferrimagnetisms

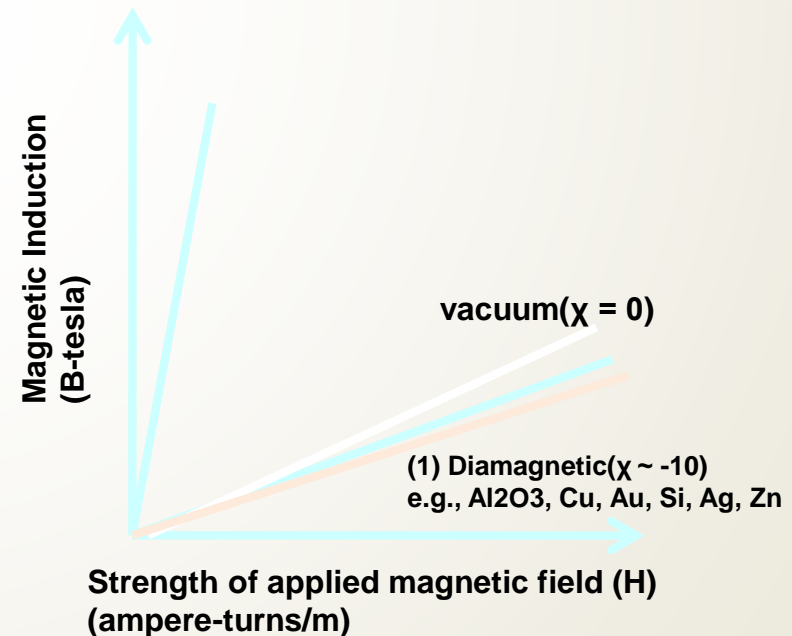
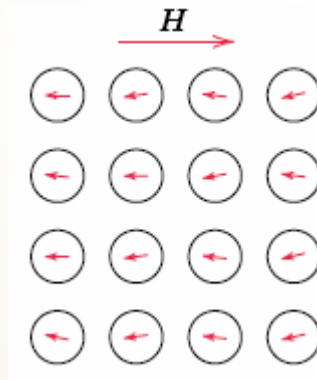
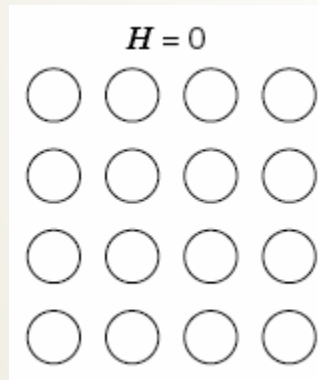


# Diamagnetic, Paramagnetic, Ferromagnetic, Ferrimagnetic, and Superparamagnetic Materials

- **Ferromagnetism** - Alignment of the magnetic moments of atoms in the same direction so that a net magnetization remains after the magnetic field is removed.
- **Ferrimagnetism** - Magnetic behavior obtained when ions in a material have their magnetic moments aligned in an antiparallel arrangement such that the moments do not completely cancel out and a net magnetization remains.
- **Diamagnetism** - The effect caused by the magnetic moment due to the orbiting electrons, which produces a slight opposition to the imposed magnetic field.
- **Antiferromagnetism** - Arrangement of magnetic moments such that the magnetic moments of atoms or ions cancel out causing zero net magnetization.
- **Hard magnet** - Ferromagnetic or ferrimagnetic material that has a coercivity  $> 10^4 \text{ A} \cdot \text{m}^{-1}$ .

# DIAMAGNETISM

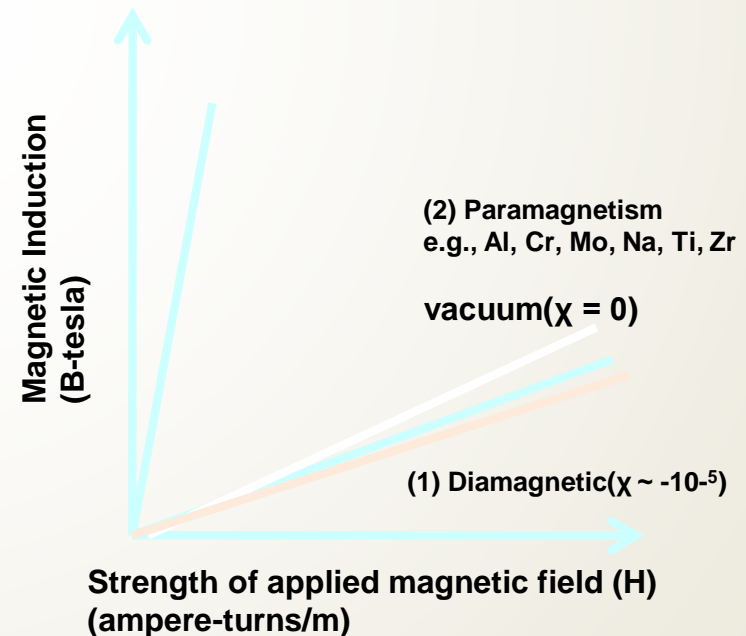
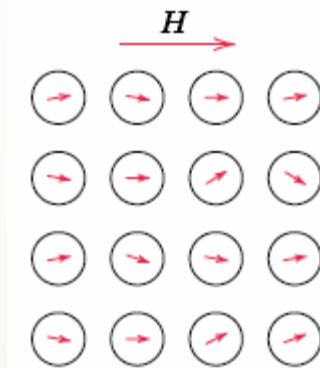
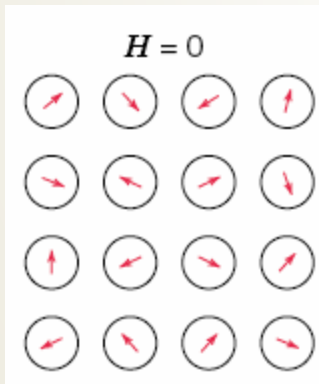
- Very weak and in opposite direction of applied field.
- Exists only during application of external field
- Induced by change in orbital motion of electrons
- Found in all materials
- $\mu_r$  slightly less than 1 and  $\chi_m$  is negative
- This form of magnetism is of no practical importance





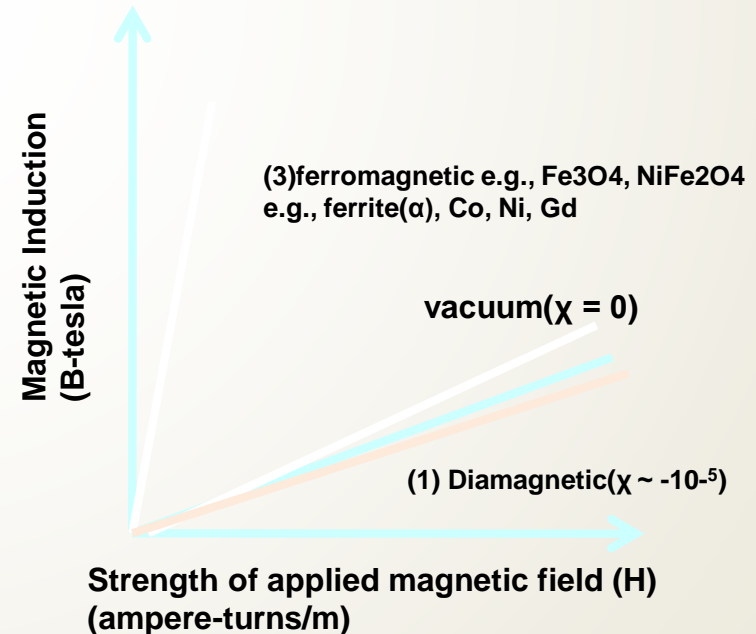
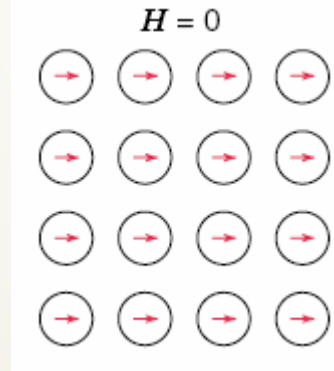
# PARAMAGNETISM

- ❖ In some solids, atoms possess permanent dipole moments
- ❖ Dipoles align with external field
- ❖ Enhances external field
- ❖ Increases  $\mu_r$



# FERROMAGNETISM

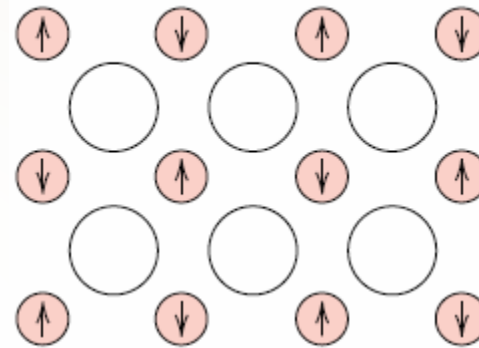
- ❖ No external field required
- ❖ Very large and permanent magnetizations
- ❖ Moments primarily due to electron spin exchange interaction
- ❖ Coupling interaction causes adjacent atoms to align
- ❖ Often found in transition metals
- ❖ Large  $\chi_m$ ,  $H \ll M$  and  $B \sim \mu_0 * M$



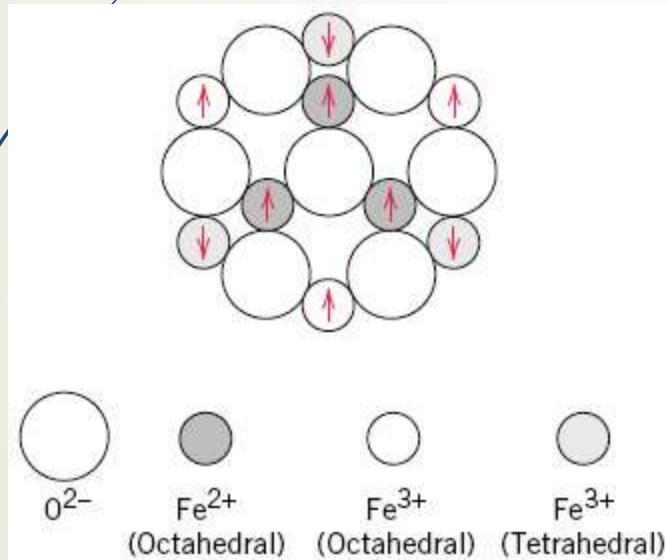
# ANTIFERROMAGNETISM AND FERRIMAGNETISM

## Antiferromagnetism

- Atoms' spin moments couple in opposite directions
- No magnetic moment



MnO



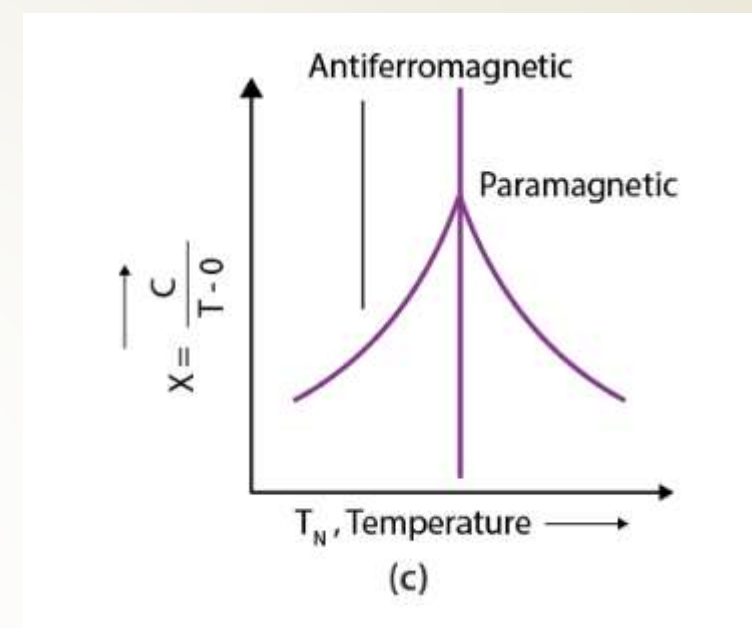
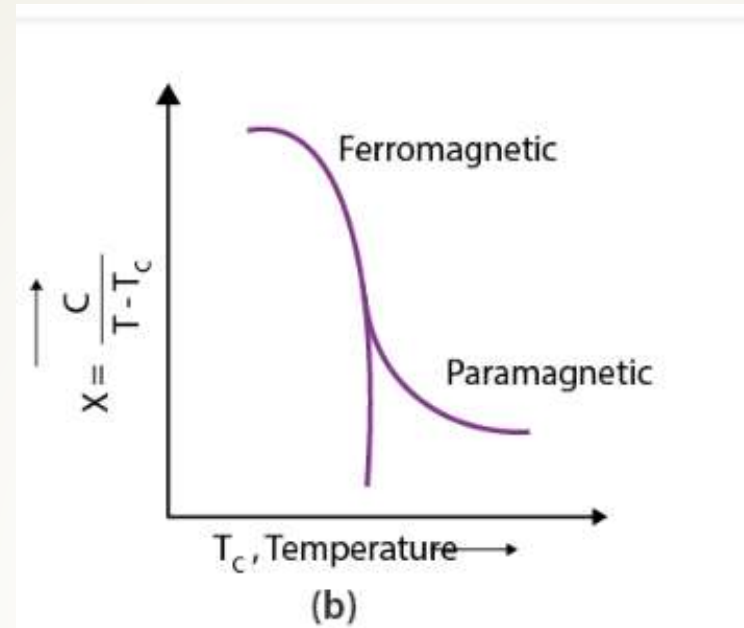
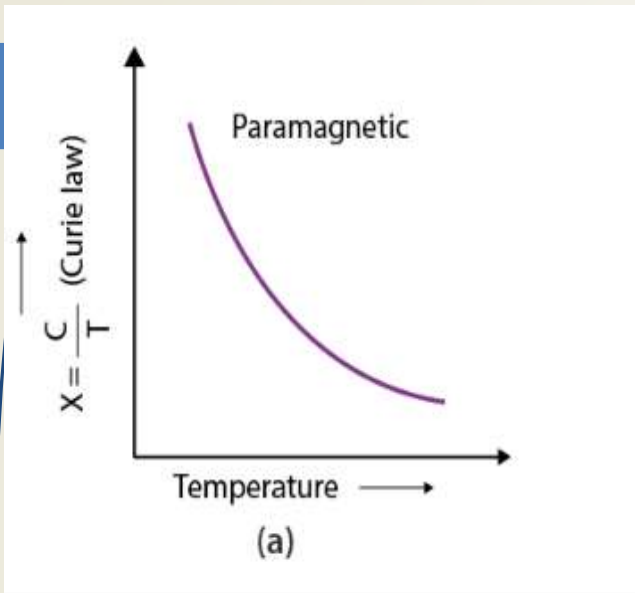
$Fe^{3+}$  complete cancellation  
 $Fe^{2+}$  there is net magnetic moment

$Fe_3O_4$



## Ferrimagnetism

- Permanent magnetization
- Similar macroscopic characteristics with ferromagnetism
- Source of moment is incomplete cancellation of spin moments



Graphs showing the variation of magnetic properties on changing temperature:

In paramagnetic material, with the increase in the magnetic field, the magnetization of the material increases.

When the material is heated the magnetization starts decreasing, so the magnetization of the material is inversely proportional to temperature.

This relationship is known as Curie's law.

$$M = C \times (B/T)$$

Where, M = magnetization of the material, C= Curie's constant, B= applied magnetic field

T= Temperature



# Magnetic Properties



- ▶ These magnetic moments come from two types of motion of electrons:
- ▶ The orbital movement around the nucleus of an atom.
- ▶ When the electron spins around its own axis.
- ▶ On the basis of the magnetic properties solids can be classified as follows:

Properties	Description	Alignment of magnetic dipoles	Examples	Application
Diamagnetic	They are weakly repelled by the magnetic fields	All the electrons in the orbitals are paired and are completely filled.	NaCl, Benzene	Behaves like an insulator.
Paramagnetic	They are weakly attracted by the magnetic fields.	Contains at least one unpaired electron in the orbital.	O <sub>2</sub> , Cu <sup>2+</sup> etc.	Electronic appliances
Ferromagnetic	Strongly attracted by the magnetic field. It can be magnetized permanently	Consists of unpaired electrons, all having the same direction	Cobalt, nickel, CrO <sub>2</sub> etc.	CrO <sub>2</sub> is commonly used in making cassette recorder.
Antiferromagnetic	Net magnetic moment is zero.	Dipole moments are arranged in a compensatory way	NiO, MnO, V <sub>2</sub> O <sub>3</sub> etc.	–
Ferrimagnetic	Possess small net magnetic moments	Unequal number of parallel and antiparallel arrangement of magnetic moments	Fe <sub>3</sub> O <sub>4</sub>	–



# LANGEVIN THEORY OF DIAMAGNETISM

- In absence of external magnetic field, the vector sum of magnetic moments of all the electronic orbits in each atom of diamagnetic substance is equal to zero.
- When a diamagnetic substance is placed in an external magnetic field, each electron experiences a Lorentz force in direction perpendicular to its motion due to which the angular velocity of an electron changes.
- As a result ,the magnetic moment of an electron also changes and the net magnetic moment of the atom is not zero, but some magnetic moment is induced in the atom in direction opposite to the external magnetic field.
- Langevin gave a satisfactory explanation of diamagnetism on the basis of electron theory the basic principle of which is Lenz's law in electromagnetic induction which states that when a magnetic flux linked with electric current due to revolving electrons is changed, an induced current is set up in such a direction as to oppose the change in flux.

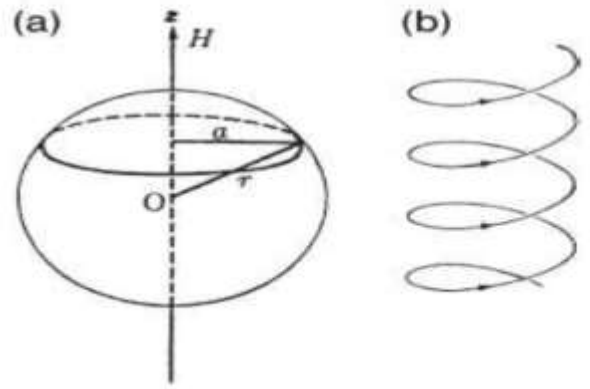
- ▶ Langevin gave a theory to explain the experimental results of Curie. This concludes susceptibility of a diamagnetic material is independent of temperature and field strength.
- ▶ According to him an electron revolving in a circular orbit in an atom is equivalent to a magnetic shell.
- ▶ Let  $-e$  = Charge of an electron
- ▶  $\omega$  = Angular velocity of an electron
- ▶  $r$  = Radius of the circular orbit
- ▶  $T$  = Time period of an electron
- ▶ The equivalent current is given by
- ▶  $I = -e/T = -e/2\pi r \omega = -e \omega / 2\pi \dots \dots \dots (1)$



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(a) (b)


Figure (a) shows a sphere with a vertical axis labeled  $z$  and  $H$ . The center is labeled  $O$ . A horizontal radius is labeled  $a$ . A curved line on the sphere's surface is labeled  $r$ . (b) shows a vertical helical path with arrows indicating the direction of motion.

Figure (a) Electron rotation in the radius,  $a$  ;(b) cyclotron motion caused by the magnetic field.

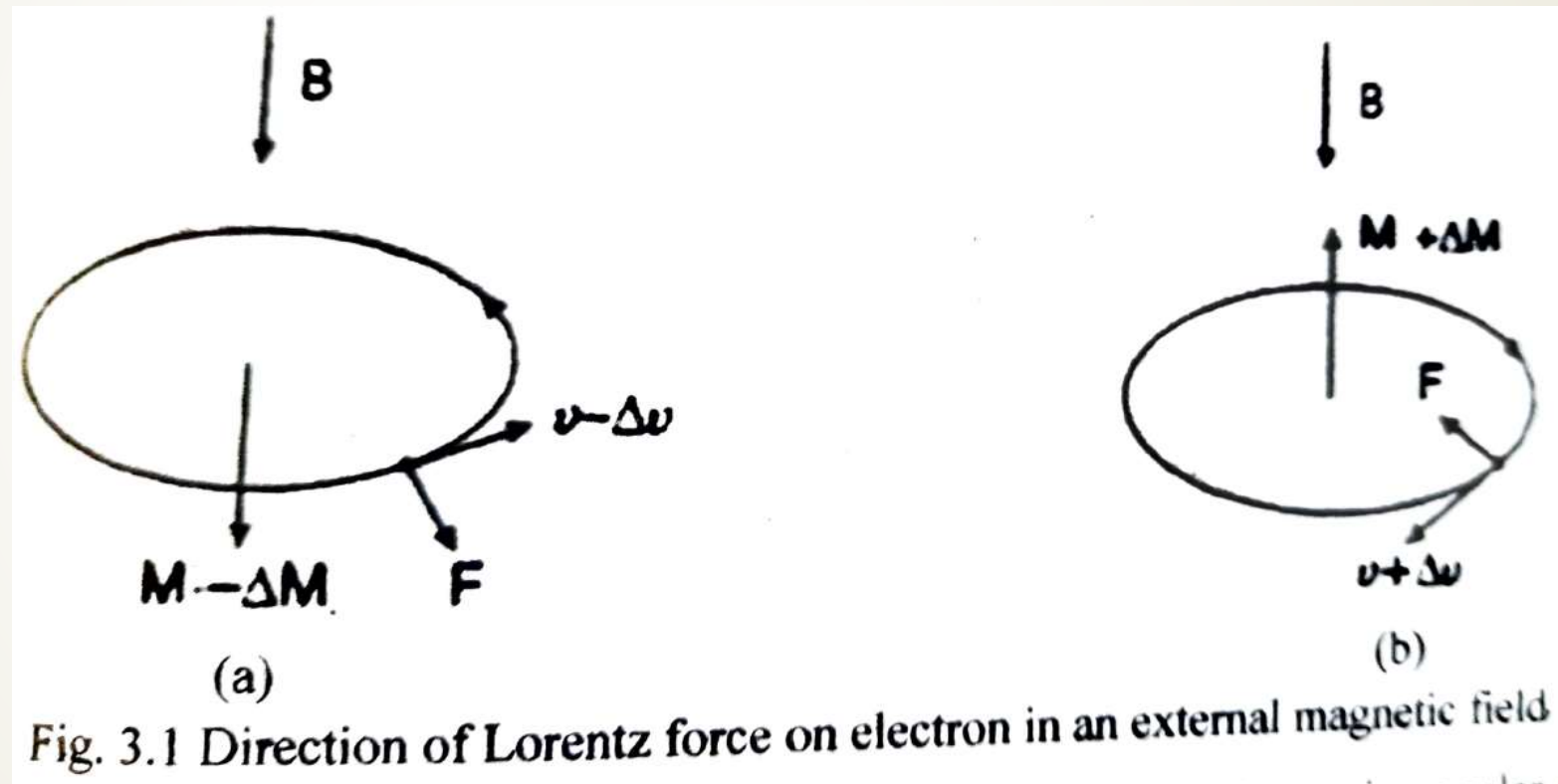
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- ▶ Now the magnetic moment of the equivalent shell is
- ▶  $M = IA = \frac{e\omega}{2\pi} \times \pi r^2$
- ▶ Where  $A = \pi r^2 = \text{Area}$
- ▶  $M = -\frac{1}{2}e\omega r^2 \dots\dots\dots(2)$
- ▶ Since the electron is moving in a circular orbit , hence centripetal force acting on it
- ▶  $F = \frac{mv^2}{r} = m\omega^2 r \dots\dots\dots(3)$
- ▶ Where  $m = \text{mass of an electron}$
- ▶ This force is acting radially inward and it is given by the coulomb force of attraction between the nucleus and the electron .

- 
- ▶ Let an external magnetic field  $B$  is applied to the plane of orbit of an electron.
  - ▶ Due to this external magnetic field, the angular velocity of an electron changes without affecting the radius of orbit.
  - ▶ When electron has anticlockwise motion,

- 
- ▶ The Lorentz force on electron ( $F_m = Bev_0 = B\omega r$ ) will be radially outwards and magnetic moment of an electron and magnetic field are in the same direction(fig.a).
  - ▶ In clockwise motion,
  - ▶ The Lorentz force on electron ( $F_m = Bev_0 = B\omega r$ ) will be radially inwards towards nucleus and magnetic moment of an electron and magnetic field are in the opposite direction(fig.b).

# Direction of Lorentz force on electron in an external magnetic field



- 
- ▶ Let  $(\omega_0 + \Delta\omega)$  be the new angular velocity where  $\Delta\omega$  is the small change in angular velocity of an electron in presence of an external magnetic field.
  - ▶  $\therefore mr(\omega_0 + \Delta\omega) = m\omega^2r \pm Be\omega r$  (+ for clockwise and – for anticlockwise)
  - ▶ Neglecting the terms containing higher powers of  $\Delta\omega$ , we get , as  $\Delta\omega$  is very small compared to  $\omega$
  - ▶  $\therefore mr(\omega_0^2 + 2\omega\Delta\omega) = m\omega^2r \pm Be\omega r$
  - ▶  $\therefore \Delta\omega = \pm \frac{Be}{2m} \dots \dots \dots (3)$
  - ▶  $\Delta\omega$ - Change in angular velocity of an electron on applying the magnetic field.
  - ▶ Angular velocity of an electron either increases or decreases by an amount  $\Delta\omega$  depending upon the direction of an external magnetic field and the direction of rotation of an electron.

This change in angular velocity  $\Delta\omega$  of an electron on applying the magnetic field is called the **Larmour frequency**.

- ▶ If projection of radius of orbit  $r_0$  in a plane normal to the magnetic field is  $r$ ,
- ▶ From Eq.(1), the change in magnetic moment of an electron due to change in angular velocity is given by


$$\Delta M = -\frac{1}{2}er^2\Delta\omega$$

- ▶ Substitute value of  $\Delta\omega$ , we get

$$\Delta M = -\frac{e^2r^2}{4m}B \dots \dots (4)$$

- ▶ Induced magnetic moment  $\Delta\mu$  is always opposite to the direction of external magnetic field B.



- 
- ▶ If there are  $Z$  electrons in the atom, then total induced magnetic moment in the atom is
  - ▶ 
$$\Delta M = -\frac{Ze^2B}{4m}\overline{r^2} \dots \dots (4)$$
  - ▶  $\overline{r^2}$ -Mean value of square projections of radii of orbits of electrons in a plane perpendicular to the magnetic field.
  - ▶ If the coordinates of a point of orbit of radius  $r_0$  are  $x, y, z$ , then
  - ▶ 
$$r_0^2 = \overline{x^2} + \overline{y^2} + \overline{z^2}$$
  - ▶ For spherically symmetric distribution of an electrons orbiting in the atoms,  $\overline{x^2} = \overline{y^2} = \overline{z^2}$



➤ If the magnetic field is along the z-axis ,then

➤  $r^2 = \overline{x^2+y^2}=2\overline{x^2} = \frac{2}{3} r_0^2$

➤ Eq(5) becomes

➤  $\Delta M = -\frac{Ze^2B}{4m} \frac{2}{3} r_0^2$

➤  $\Delta M = -\frac{Ze^2B}{6m} r_0^2 \dots \dots (6)$

➤ If No.of atoms per unit volume of the substance is  $n$ ,the induced magnetic moment per unit volume of the substance is

➤  $I = -\frac{nZe^2B}{6m} r_0^2 \dots \dots (6)$

- ▶ But,  $B = \mu H$
- ▶  $\mu$  – absolute permeability of the substance
- ▶  $I = -\frac{nZe^2r_0^2}{6m} \mu H \dots\dots(8)$
- ▶ But, Intensity of magnetization  $I \propto H$  or  $I = \chi H$
- ▶  $\chi$ -Magnetic susceptibility of the substance.
- ▶ Therefore, Magnetic susceptibility per unit volume of the diamagnetic substance is given from Eq.(8) as
- ▶  $\chi = \frac{I}{H}$
- ▶  $\chi = -\frac{nZe^2r_0^2}{6m} \mu \dots\dots(9)$
- ▶ Eq.(9) gives diamagnetic susceptibility of substance.
- ▶  $\chi$  not depends on temperature and intensity of external magnetic field
- ▶  $\chi$  is always –ve.

## Classical Langevin theory of Paramagnetic Domains

- **Langevin considered a paramagnetic gas containing  $N$  atoms per unit volume each having a permanent magnetic moment  $\mu$ .** The mutual interaction between the magnetic dipoles was assumed to be negligible.
- A paramagnetic material is one which when placed in a magnetic field becomes weakly magnetised in the same.
- Substance having odd number of electrons in the outermost orbit has a permanent magnetic moments.
- In absence of external magnetic, the atomic magnets are randomly oriented within the entire substance, thus net magnetic moment is zero.
- When paramagnetic material kept under external magnetic field, all the atomic magnets aligned themselves in the direction of external magnetic field.

- ▶ At any temperature , total magnetic moment of material is equal to the vector sum of magnetic moments of all the atomic magnetic dipoles present in it, in the direction of external magnetic field .
- ▶ Let,  $n$ -No.of atoms present per unit volume of the paramagnetic substance.
- ▶  $M$ - permanent magnetic moment of each atom.
- ▶ If the axis of an atomic magnetic dipole makes an angle  $\theta$  with the direction of external magnetic field  $B$ , then
- ▶ PE of magnetic dipole  $U = -MB\cos\theta$
- ▶ Acc. To Boltzman canonical law, the probability of finding the magnetic dipole at an angle  $\theta$  with the external magnetic field  $B$  at an absolute temp.  $T$  is
- ▶  $T \propto e^{-U/kT}$  i.e.  $e^{MB\cos\theta/kT}$  where  $k$ -Boltzman Constant.

➤ No. of atomic magnetic dipoles in between the angles  $\theta$  and  $\theta+d\theta$  from the direction of magnetic field is given as

➤  $dn = A \cdot e^{MB\cos\theta/kT} d\omega \dots \dots (1)$

➤ A- Constant of proportionality

➤  $d\omega$  – Solid angle subtended between the angles  $\theta$  and  $d\theta$

➤  $d\omega = \frac{\text{Area of annular ring between the angles } \theta \text{ and } d\theta}{(\text{Distance})^2} = \frac{2\pi r \sin\theta \cdot r d\theta}{r^2} = 2\pi \sin\theta d\theta$

➤  $(1) \Rightarrow dn = A \cdot e^{MB\cos\theta/kT} 2\pi \sin\theta d\theta \dots \dots (2)$

➤ On integrating eq.(2) with limit  $\theta=0$  to  $\pi$

➤  $n = \int dn = \int_0^\pi A \cdot e^{MB\cos\theta/kT} 2\pi \sin\theta d\theta$

➤  $\therefore A = \frac{n}{2\pi \int_0^\pi A \cdot e^{MB\cos\theta/kT} \sin\theta d\theta}$

➤ (2)  $\Rightarrow dn = \frac{2\pi n \cdot e^{MB \cos \theta / kT} \sin \theta d\theta}{2\pi \int_0^\pi e^{MB \cos \theta / kT} \sin \theta d\theta}$

➤  $dn = \frac{n \cdot e^{MB \cos \theta / kT} \sin \theta d\theta}{\int_0^\pi e^{MB \cos \theta / kT} \sin \theta d\theta} \dots \dots \dots (3)$

➤ Component of magnetic moment of a dipole in the direction of magnetic field =  $M \cos \theta$  and the magnetic moment of magnetic dipoles present within the angles  $\theta$  and  $d\theta$  from the direction of magnetic field =  $(M \cos \theta) dn$ .

➤ Therefore, total magnetic moment per unit volume of the substance (Intensity of magnetization) is

➤  $I = \int_0^\pi (M \cos \theta) dn$



- Substitute value of dn

$$I = \frac{n \int_0^\pi (M \cos \theta) e^{MB \cos \theta / kT} \sin \theta d\theta}{\int_0^\pi e^{MB \cos \theta / kT} \sin \theta d\theta} \dots \dots \dots (4)$$

- Let  $MB/kT = a$  and  $\cos \theta = x$ , then  $-\sin \theta d\theta = dx$

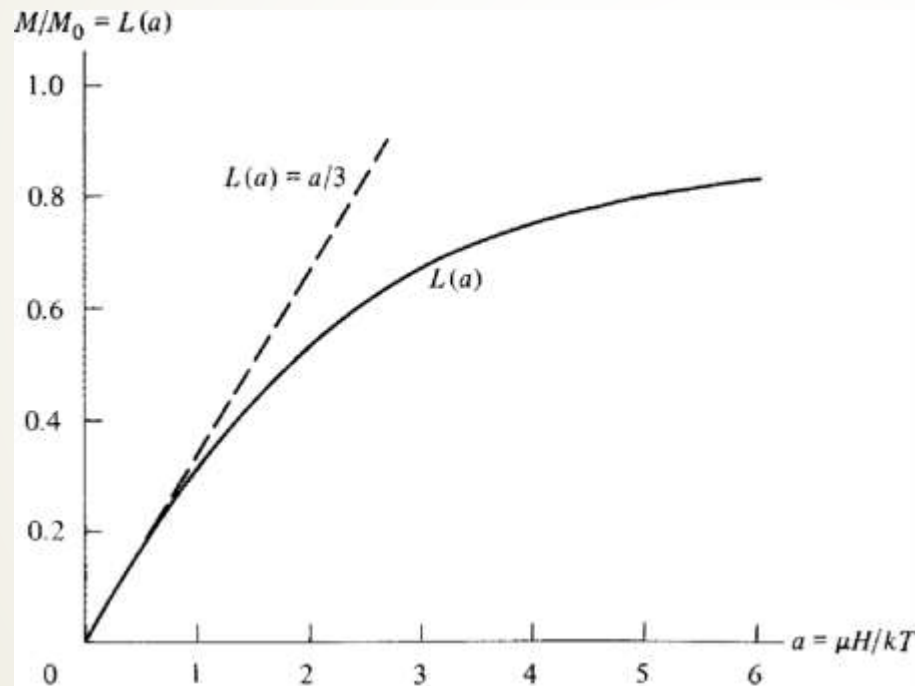
$$(4) \Rightarrow I = nM \frac{\int_{-1}^1 x e^{ax} dx}{\int_{-1}^1 e^{ax} dx}$$

$$= nM \frac{\left[ \frac{x e^{ax}}{a} - \frac{e^{ax}}{a^2} \right]_{-1}^1}{\left[ \frac{e^{ax}}{a} \right]_{-1}^1} = nM \frac{\left[ \frac{e^a + e^{-a}}{a} - \frac{e^a - e^{-a}}{a^2} \right]}{\left[ \frac{e^a - e^{-a}}{a} \right]} = nM \left[ \frac{e^a + e^{-a}}{e^a - e^{-a}} - \frac{1}{a} \right] = nM \left[ \coth a - \frac{1}{a} \right]$$

$$I = I_0 \left[ \coth a - \frac{1}{a} \right] \dots \dots \dots (5)$$

- Where,  $nM = I_0$  - saturated intensity of magnetization when all magnetic dipoles get aligned in the direction of external magnetic field.
- The function  $\left[ \coth a - \frac{1}{a} \right]$  is called the Langevin function, represented by  $L(a)$

# Variation of $L(a)$ with $a$



- ▶ When  $a = \mu B/kT$  is very large, then  $L(a) \rightarrow 1. \therefore I = I_0$ .
- ▶ At very low temp. (or in a strong external mag. field). all the mag. dipoles get aligned in the direction of external mag. field and saturated magnetism is obtained.



- ▶ When  $\alpha = MB/kT$  is extremely low, then  $L(\alpha)$  approximates to  $MB/3kT$ .
- ▶  $\therefore (5) \rightarrow I = I_0 \left[ \frac{MB}{3kT} \right]$
- ▶  $I = nM \left[ \frac{MB}{3kT} \right] \dots \dots \dots (Since I_0 = nM)$
- ▶  $I = \left[ \frac{nM^2 B}{3kT} \right]$
- ▶ But  $B = \mu H$
- ▶ Where,  $\mu$ -absolute magnetic permeability of the paramagnetic substance.
- ▶  $\therefore I = \left[ \frac{nM^2 \mu H}{3kT} \right] \dots \dots \dots (6)$
- ▶ As  $I \propto H$  or  $I = \chi H$
- ▶  $\therefore \chi = \frac{I}{H} = \frac{n\mu M^2}{3kT} = \frac{C}{T}$
- ▶ Where  $C = \frac{n\mu M^2}{3k}$  – Curie constant
- ▶  $\chi = \frac{C}{T}$  Curie law.
- ▶ Mag. Susceptibility is inversely proportional to its absolute temperature.



# Quantum Mechanical treatment of paramagnetism



➤ No. of atomic magnetic dipoles in between the angles  $\theta$  and  $\theta+d\theta$  from the direction of magnetic field is given as

➤  $dn = A \cdot e^{MB\cos\theta/kT} d\omega \dots \dots (1)$

➤ A- Constant of proportionality

➤  $d\omega$  – Solid angle subtended between the angles  $\theta$  and  $d\theta$

➤  $d\omega = \frac{\text{Area of annular ring between the angles } \theta \text{ and } d\theta}{(\text{Distance})^2} = \frac{2\pi r \sin\theta \cdot r d\theta}{r^2} = 2\pi \sin\theta d\theta$

➤  $(1) \Rightarrow dn = A \cdot e^{MB\cos\theta/kT} 2\pi \sin\theta d\theta \dots \dots (2)$

➤ On integrating eq.(2) with limit  $\theta=0$  to  $\pi$

➤  $n = \int dn = \int_0^\pi A \cdot e^{MB\cos\theta/kT} 2\pi \sin\theta d\theta$

➤  $\therefore A = \frac{n}{2\pi \int_0^\pi A \cdot e^{MB\cos\theta/kT} \sin\theta d\theta}$

# LARMOR THEOREM.

- ▶ The additional current produced due to change in frequency of the electron is given by  $I = -e^2B/4\pi m$  and the change in magnetic moment is given by

$$\Delta M_a = -e^2r^2B/4m$$

- ▶  $\langle r^2 \rangle = \langle x^2 \rangle + \langle y^2 \rangle$  and  $\langle r_0^2 \rangle = \langle x^2 \rangle + \langle y^2 \rangle + \langle z^2 \rangle$

- ▶  $\langle r^2 \rangle = 2/3 \langle r_0^2 \rangle$

- ▶ Magnetization,  $M = -e^2Z\mu_0HN \langle r_0^2 \rangle / 6m$

- ▶ Susceptibility,  $\chi = M/H = -e^2Z\mu_0N \langle r_0^2 \rangle / 6m$

- ▶ Since  $\chi$  is independent of temperature so the diamagnetic behavior of the material does not change into temperature.

# QUANTUM THEORY OF PARAMAGNETISM

According to quantum theory, the magnetic moments are quantized, so they can orient only in specific direction with respect to the magnetic field.

$$\mu = -g \mu_B J \quad \mu_B \text{ is called}$$

Bohr magneton

$$g = 1 + (J(J+1) + S(S+1) - L(L+1)) / 2J(J+1)$$

Using Maxwell Boltzmann statistics, magnetization is given as

$$M = N \sum m_j g \mu_B e^{m_j g \mu_B / k_B T} / e^{m_j g \mu_B / k_B T}$$

**CASE I** At ordinary temperatures  $B m_j g \mu_B / k_B T \ll 1$

Using the exponential series and  $\sum m_j^2 = (1/3)J(J+1)(2J+1)$

$$M = N g^2 \mu_B^2 \mu_0 H J(J+1) / 3 k_B T$$

$$\chi_{\text{para}} = N g^2 \mu_B^2 \mu_0 P_{\text{eff}}^2$$

$$\chi = M/H$$

$$P_{\text{eff}} = g \sqrt{J(J+1)}$$

➔ CASE II At low temperature and strong magnetic field  $Bm_J g \mu_B / k_\beta T$  is not less than unity

➔ Let  $x = B g \mu_B / k_\beta T$   $M = \sum Bm_J g \mu_B e^{mJx}$

➔ As  $\sum mJ x$  is a geometric progression with  $(2J+1)$  terms

➔  $M = Ng\mu_B \frac{d}{dx} (\ln( e^{Jx} (1 - e^{-(2J+1)x}) / (1 - e^{-x}) ))$

➔  $= NgJ\mu_B B_J(a)$

➔  $B_J(a) = (2J+1)/2J \coth (2J+1)a/2J - 1/2J \coth (a/2J)$ , Brillouin function  $a = Jg\mu_B/k_\beta T$

➔ In the limit  $J$  tends to  $\infty$  Brillouin function approaches the Langevin function i.e., infinite number of possible orientations are allowed.

# WEISS THEORY OF FERROMAGNETISM

The Weiss theory is centered about the following two hypothesis :

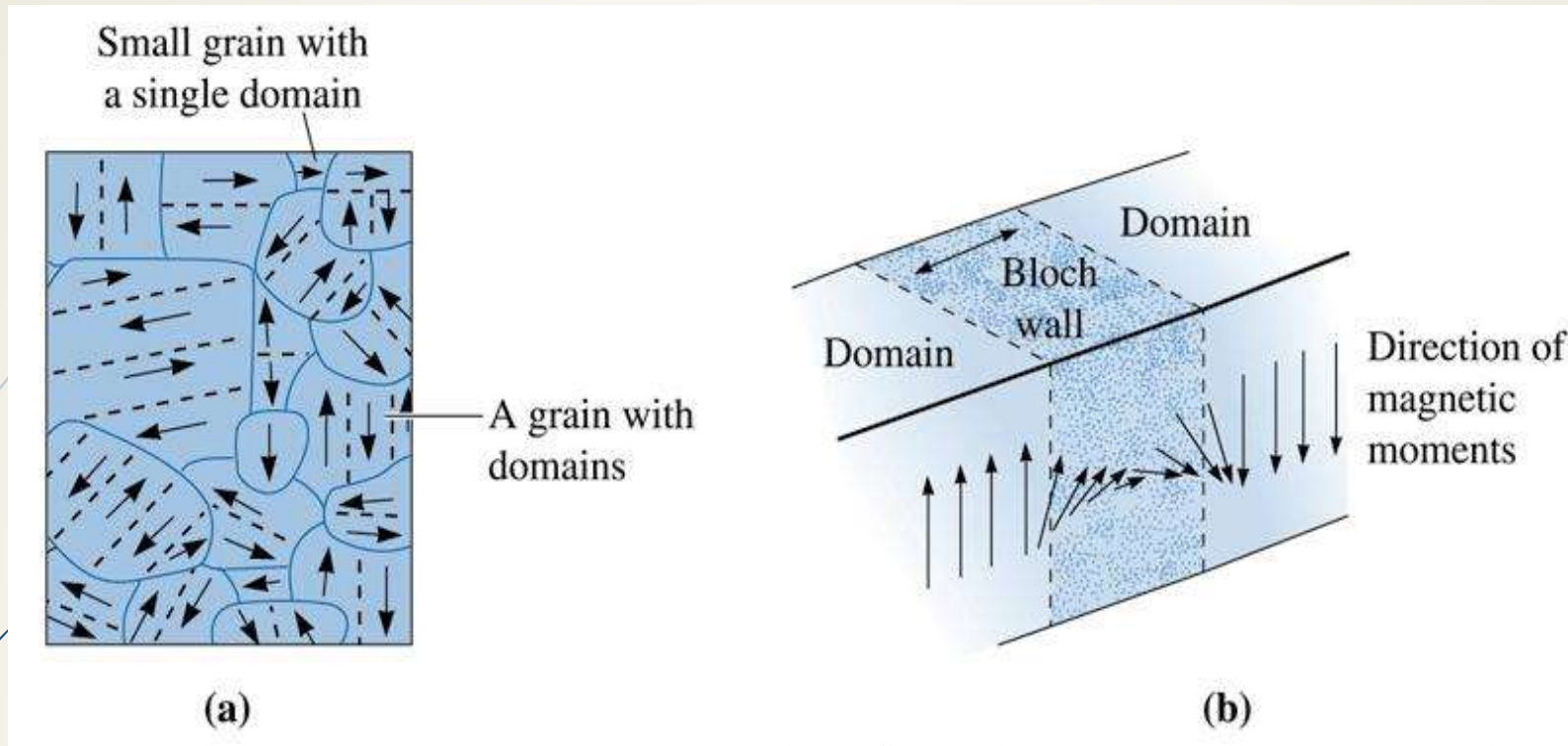
- A ferromagnetic substance contains a number of small regions called domains which are spontaneously magnetized.
- The value of spontaneous magnetization of the specimen is determined by the vector sum of the magnetic moments of the individual domains.
- The spontaneous magnetization within each domain is due to the existence of a molecular field which produces a parallel alignment of the atomic dipoles.
- The field is assumed to be proportional to the magnetization of each domain,  $\mathbf{B} = \lambda\mathbf{M}$ .
- The magnetization of a ferromagnetic material containing  $N$  atoms per unit volume placed in the magnetic field  $B_{\text{eff}}$  is given as:

$$\mathbf{M} = NgJ \mu_B B_J(\mathbf{a}) \quad \text{with} \quad \mathbf{a} = \mathbf{Jg}\mu\mathbf{B}_{\text{eff}}/k_{\beta}T = \mathbf{Jg}\mu(\mathbf{B}+\lambda\mathbf{m})/k_{\beta}T$$



# Domain Structure and the Hysteresis Loop

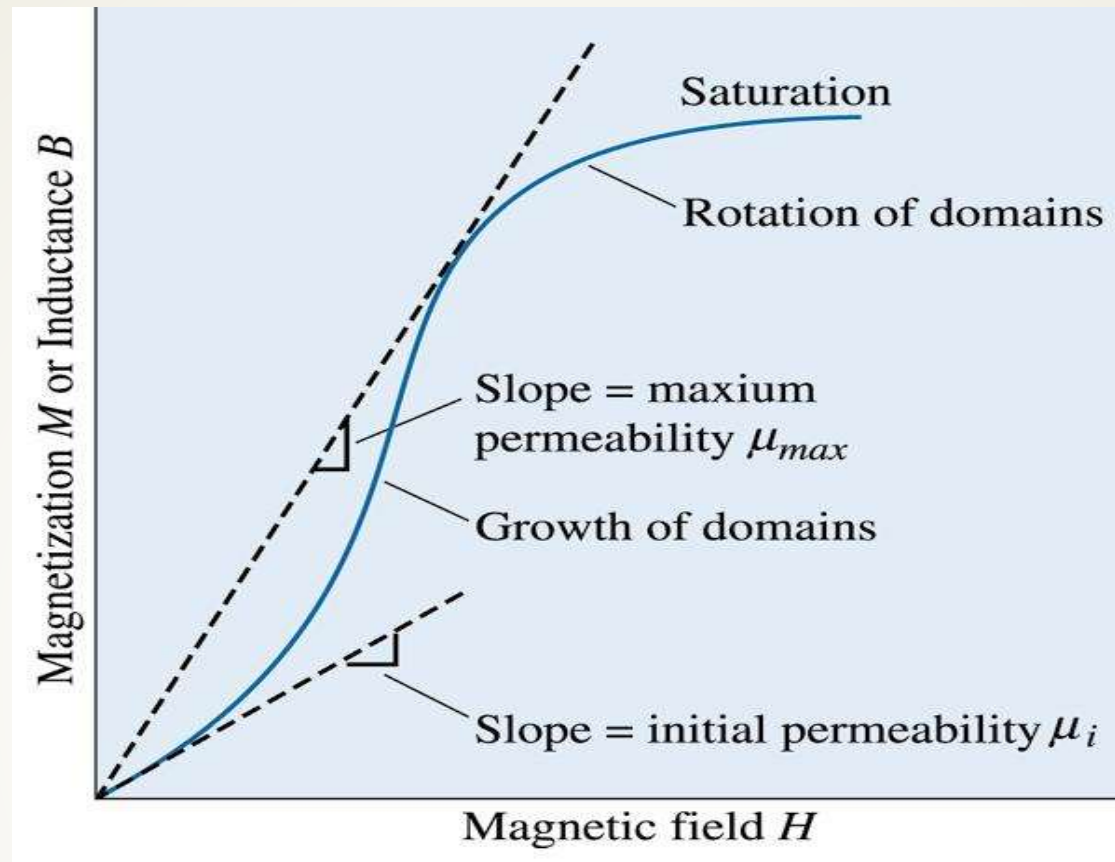
- **Domains** - Small regions within a single or polycrystalline material in which all of the magnetization directions are aligned.
- **Bloch walls** - The boundaries between magnetic domains.
- **Saturation magnetization** - When all of the dipoles have been aligned by the field, producing the maximum magnetization.
- **Remanance** - The polarization or magnetization that remains in a material after it has been removed from the field.
- **Hysteresis loop** - The loop traced out by magnetization in a ferromagnetic or ferrimagnetic material as the magnetic field is cycled.



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**Figure:(a) A qualitative sketch of magnetic domains in a polycrystalline material. The dashed lines show demarcation between different magnetic domains; the dark curves show the grain boundaries.**

**(b) The magnetic moments in adjoining atoms change direction continuously across the boundary between domains.**



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**Figure:** When a magnetic field is first applied to a magnetic material, magnetization initially increases slowly, then more rapidly as the domains begin to grow. Later, magnetization slows, as domains must eventually rotate to reach saturation. Notice the permeability values depend upon the magnitude of  $H$ .

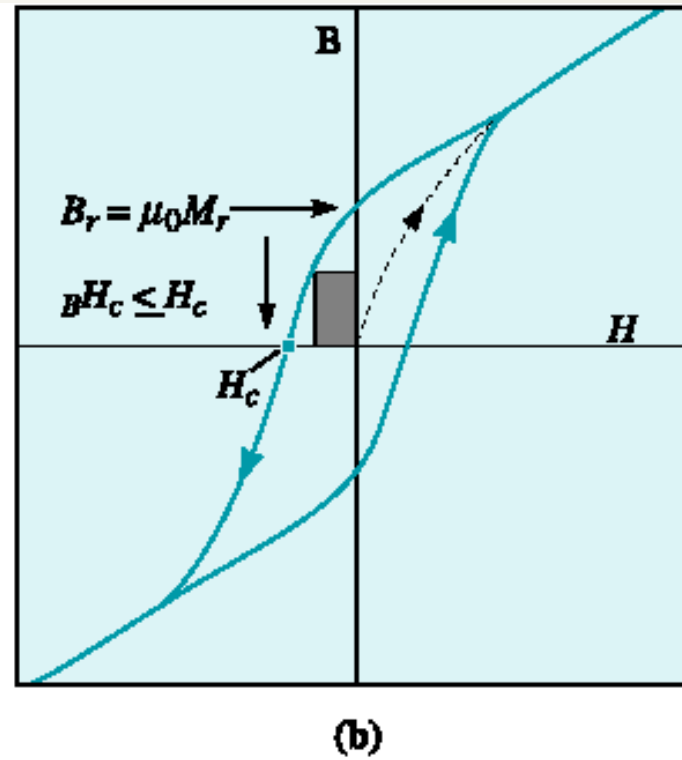
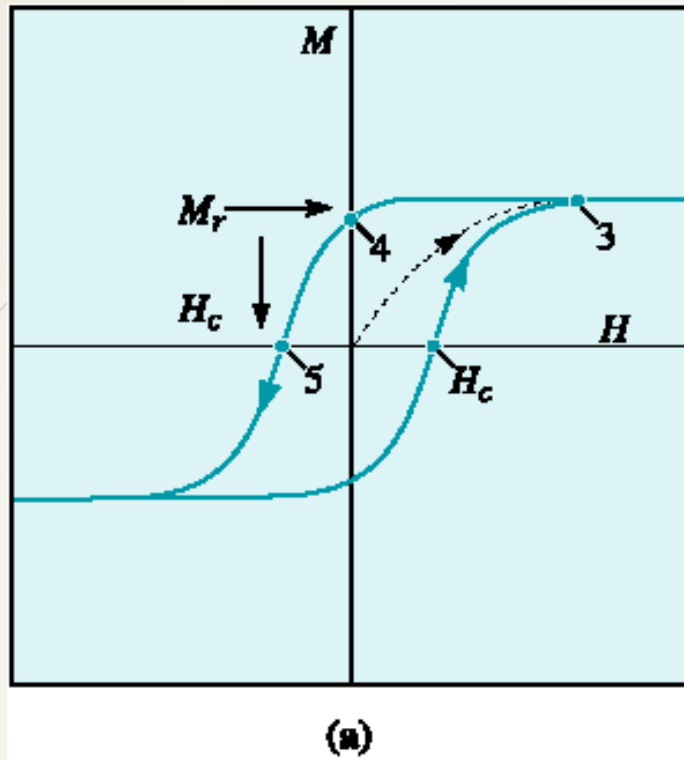
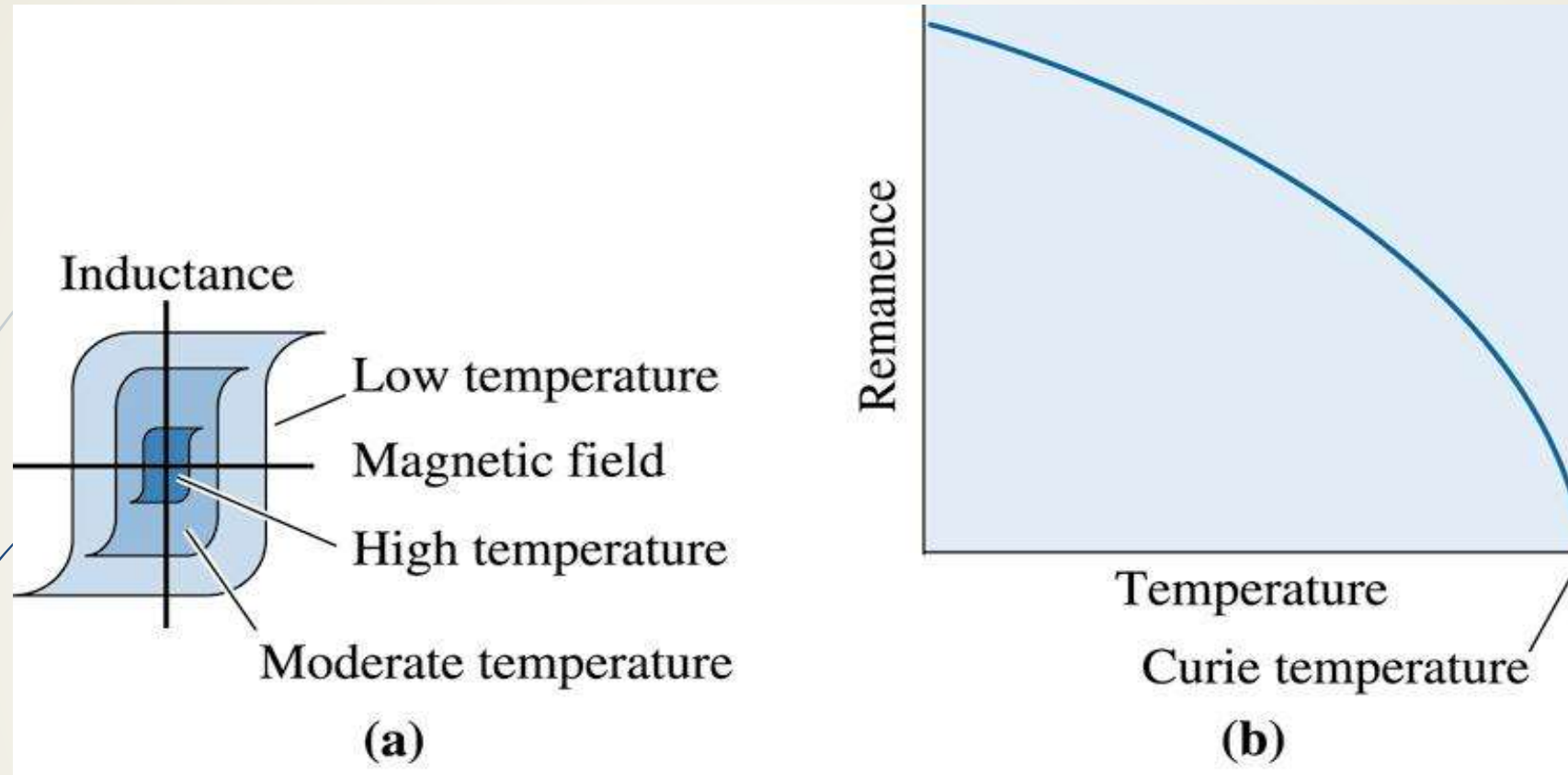


Figure:(a) The ferromagnetic hysteresis M-H loop showing the effect of the magnetic field on inductance or magnetization. The dipole alignment leads to saturation magnetization (point 3), a remanance (point 4), and a coercive field (point 5). (b) The corresponding B-H loop.

Notice the end of the B-H loop, the B value does not saturate since  $B = \mu_0 H + \mu_0 M$ .

# The Curie Temperature

- **Curie temperature** - The temperature above ( $T_c$ ) which ferromagnetic or ferrimagnetic materials become paramagnetic.



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**Figure: The effect of temperature on (a) the hysteresis loop and (b) the remanance. Ferromagnetic behavior disappears above the Curie temperature.**



**TABLE 19-3** ■ *Curie temperatures for selected materials*

<b>Material</b>	<b>Curie Temperature (°C)</b>
Gadolinium	16
Nd <sub>2</sub> Fe <sub>12</sub> B	312
Nickel	358
BaO · 6Fe <sub>2</sub> O <sub>3</sub>	469
Co <sub>5</sub> Sm	747
Iron	771
Alnico 1	780
Cunico	855
Alnico 5	900
Cobalt	1117



# Applications of Magnetic Materials

- ❑ **Soft Magnetic Materials** - Ferromagnetic materials are often used to enhance the magnetic flux density ( $B$ ) produced when an electric current is passed through the material. Applications include cores for electromagnets, electric motors, transformers, generators, and other electrical equipment.
- ❑ **Data Storage Materials** - Magnetic materials are used for data storage.
- ❑ **Permanent Magnets** - Magnetic materials are used to make strong permanent magnets
- ❑ **Power** - The strength of a permanent magnet as expressed by the maximum product of the inductance and magnetic field.

# UNIT IV - LASER

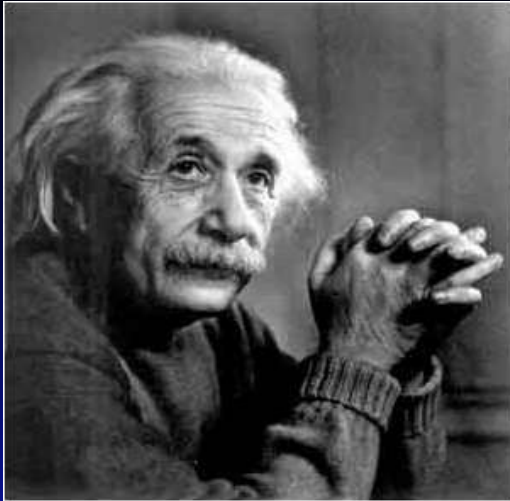


**Kalyani Vitthal Atram**  
**Assistant Professor,**  
**Department Of Physics,**  
**Anand Niketan College,**  
**Anandwan, Warora**



# LASER

Light Amplification by  
Stimulated Emission of  
Radiation.



The idea of laser is based on Albert Einstein theory of light.



Laser was developed first time by Gordon Gould in 1957



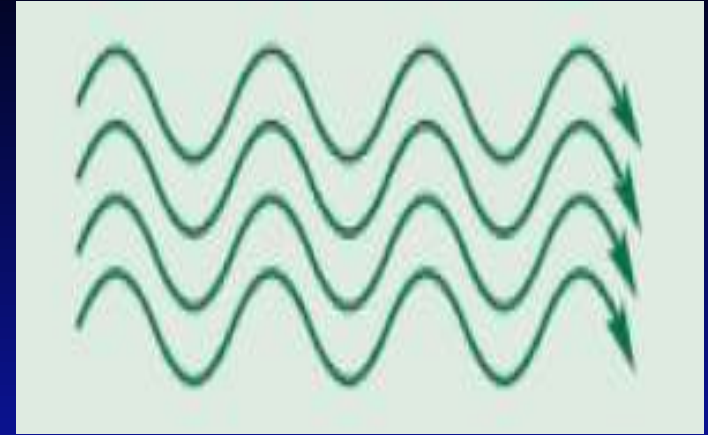
The first Laser was fabricated by Maiman in 1960

# PROPERTIES OF LASER

- Coherence
- Directionality
- Intensity
- Monochromaticity

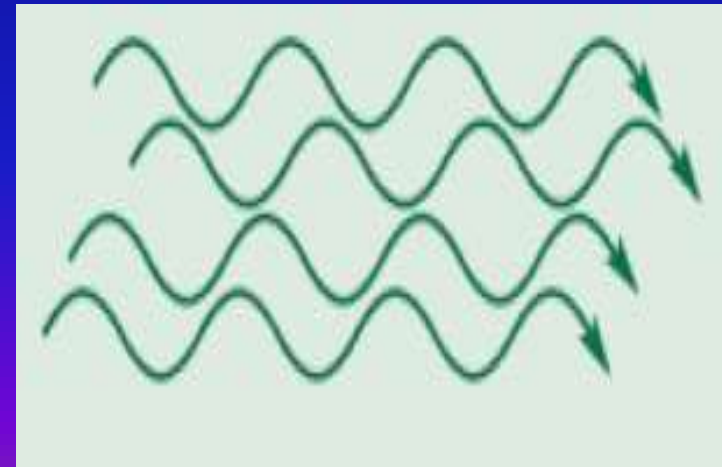
## Coherence:

The two or more than two waves are said to be coherent if they have same wavelength and frequency and also there is a constant phase difference.



## Incoherence:

The two or more than two waves are said to be incoherent if they have different wavelength and frequency and also there is a constantly changing phase difference.

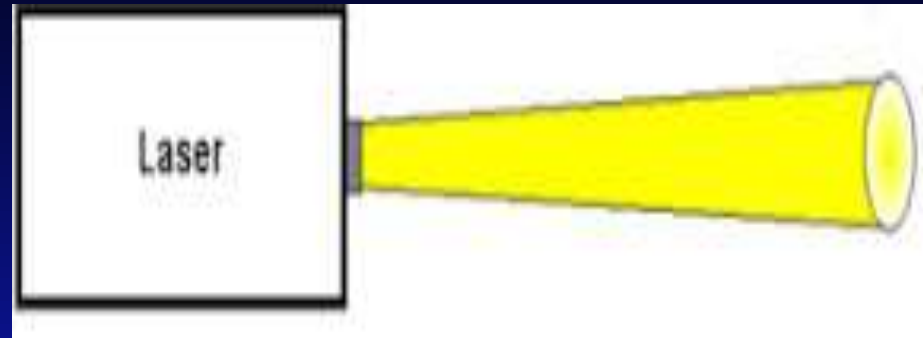


## Directionality:



Ordinary light  
source

An ordinary light source emits light in all directions.



Laser light  
source

Laser source emits radiation only in one direction i.e. a laser beam is highly directional.



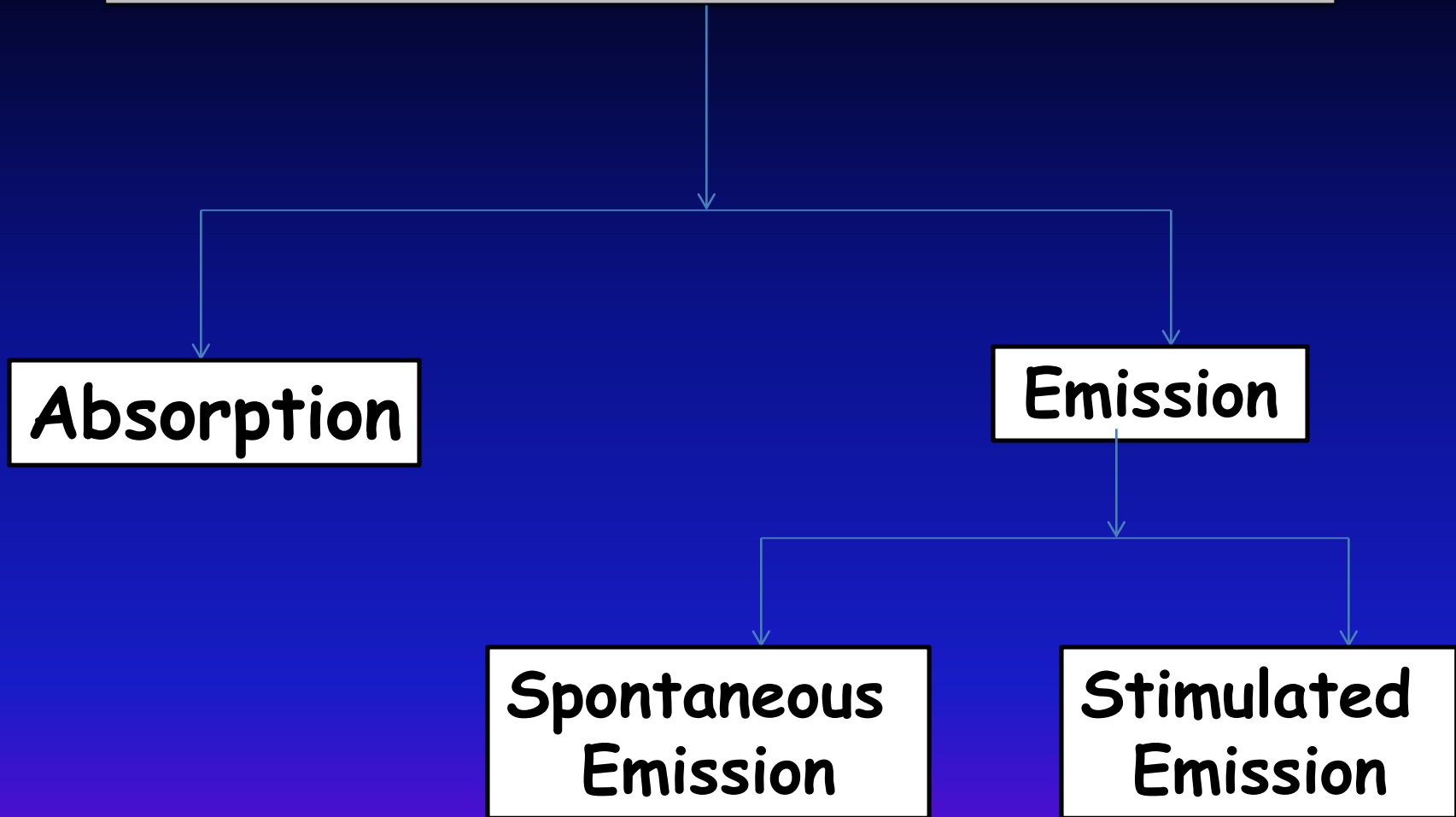
## Intensity:

The laser beam is much larger and intense than that from any of the conventional source.

## Monochromaticity:

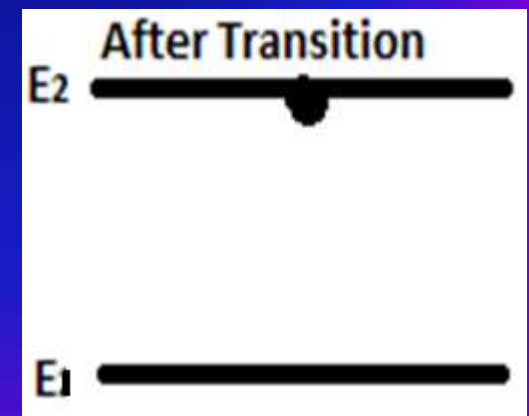
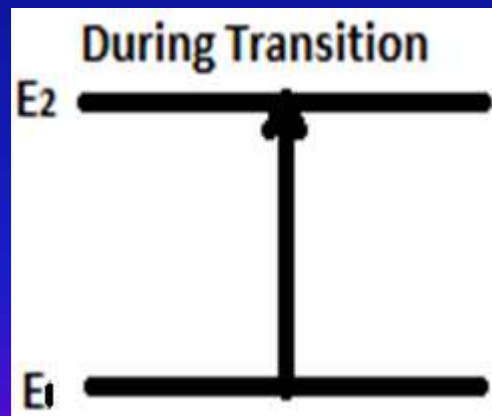
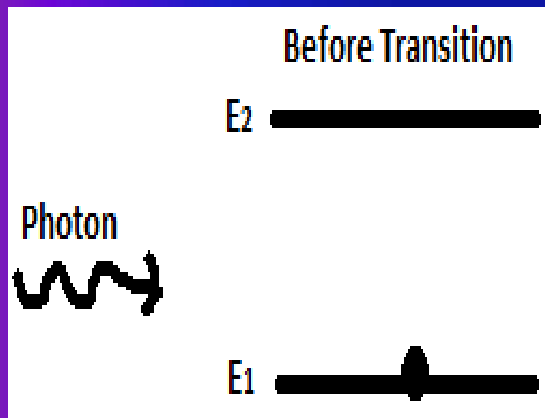
Light from a Laser beam is highly monochromatic; it contains only one wavelength while light from ordinary source is never monochromatic.

# Interaction of Radiation With Matter



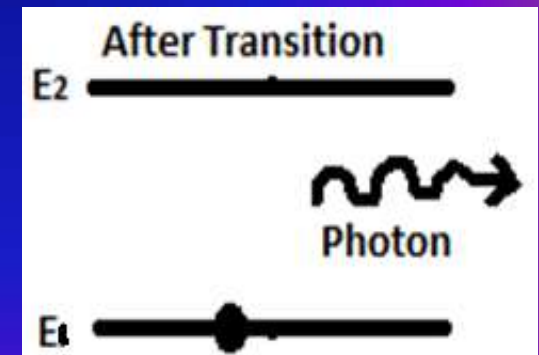
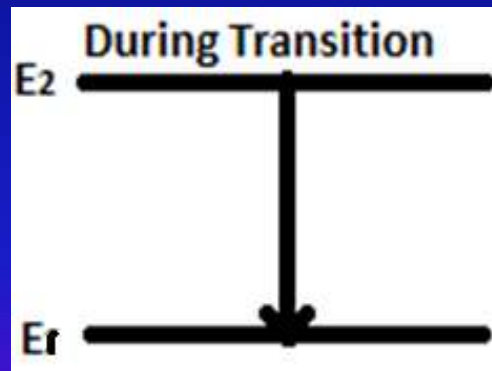
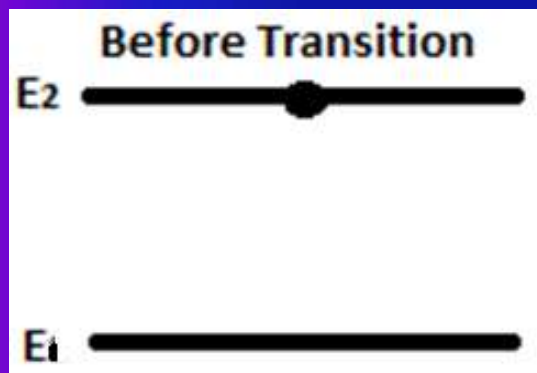
# Absorption

When light radiation (photon) is incident on matter (an atom), the atom absorbs the photon and jumps to higher energy level. This transition is known as Absorption.



# Spontaneous Emission

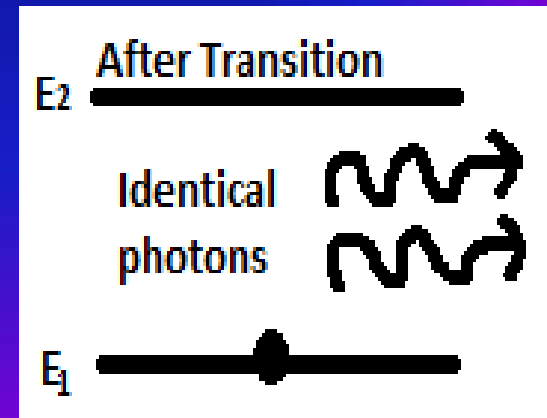
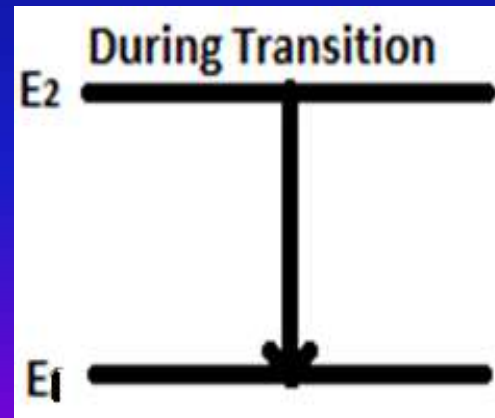
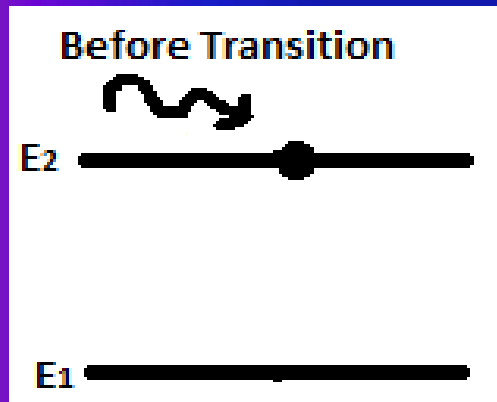
An atom remains in an excited state for only  $10^{-8}$  seconds. Atoms or molecules in the excited state can spontaneously emit a photon of energy  $h\nu$ . This process of emission of a photon without the influence of any external agency is called Spontaneous Emission.



$$h\nu = E_2 - E_1$$

# Stimulated Emission

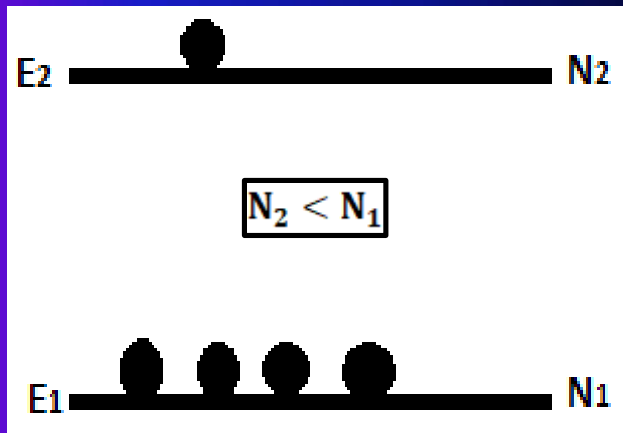
If an atom is in excited state, then the external photon of energy may cause the atom to jump lower energy state. During this transition atom emits an additional photon of same energy as the energy of incident photon. Thus two identical photons are emitted. This phenomenon is called Stimulated Emission.



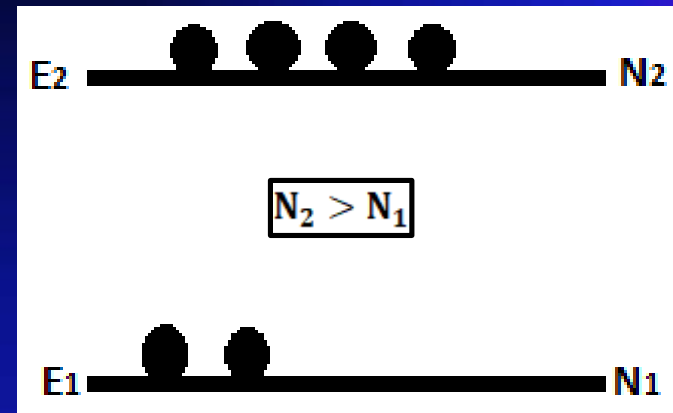
# BASIC REQUIREMENTS FOR PRODUCTION OF LASER

- Population Inversion
- Pumping
- Meta stable state
- Active medium

# Population Inversion



Ordinary Condition



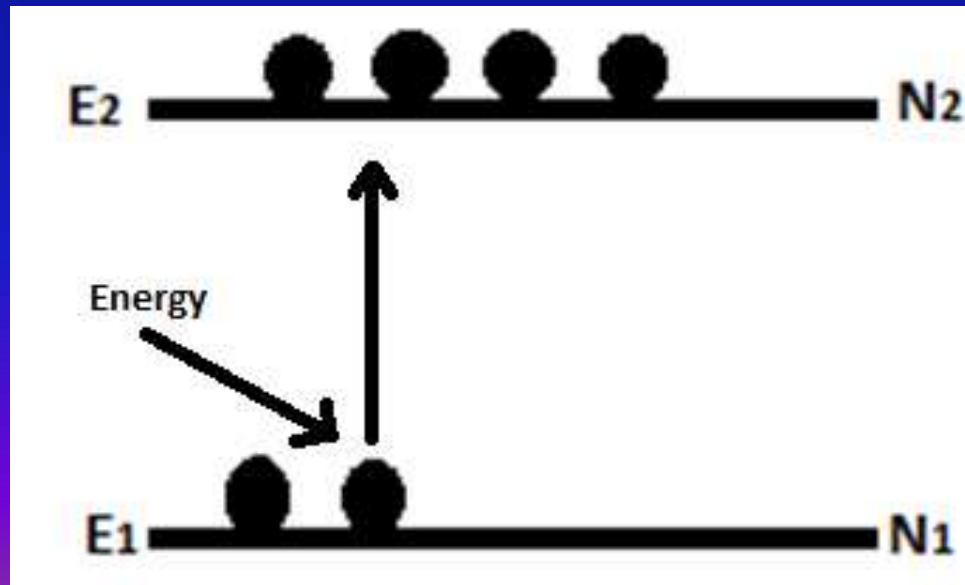
Population Inversion Condition

When there are more atoms in the upper energy level than in the lower energy level, this non equilibrium condition of lasing action is called as population Inversion



# Pumping

The process of supplying energy to achieve the condition of population inversion is known as Pumping.



**Pumping**

```
graph TD; Pumping --> Optical; Pumping --> Electrical; Pumping --> Direct; Pumping --> Chemical; Optical --> Light; Electrical --> Electrical_discharge[Electrical discharge]; Direct --> Conversion[Conversion of Electrical energy to Light energy]; Chemical --> Chemical_energy[Chemical energy];
```

**Optical**

**Light**

**Electrical**

**Electrical  
discharge**

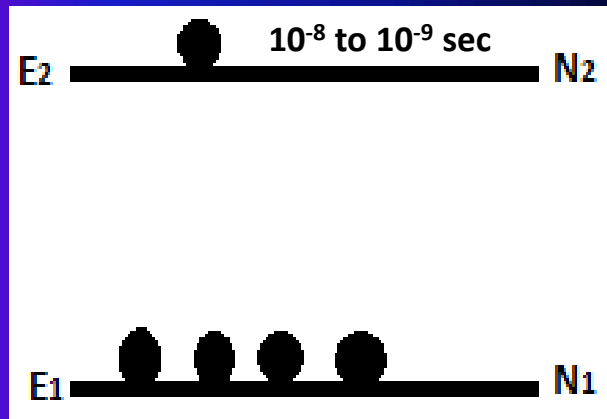
**Direct**

**Conversion  
of  
Electrical  
energy  
to  
Light  
energy**

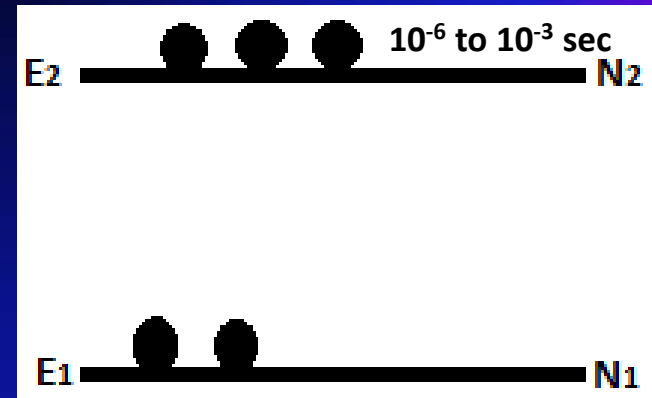
**Chemical**

**Chemical  
energy**

# Metastable state



Normal tendency



Metastable state

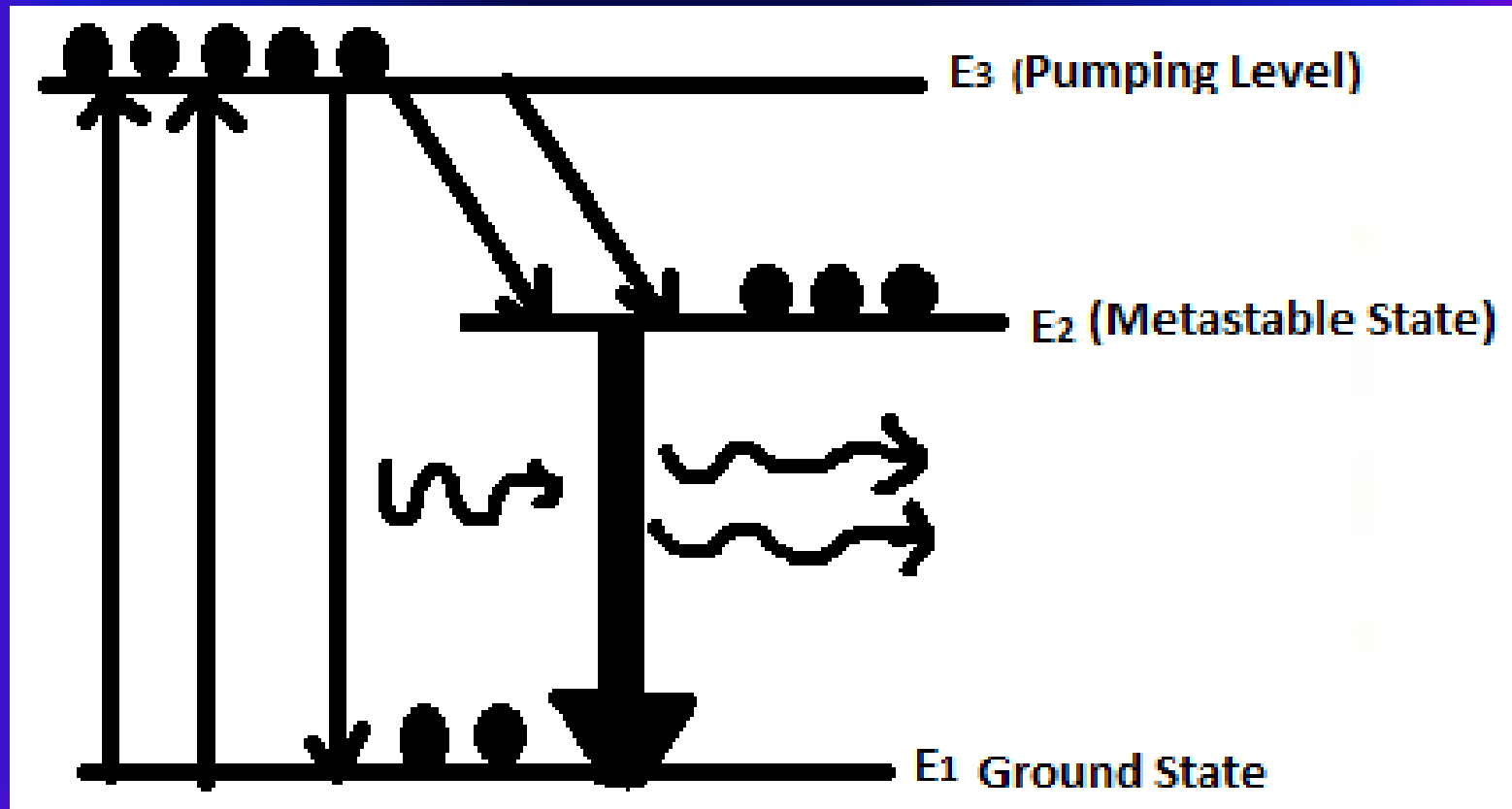
The excited state where the atoms have longer life time than its normal life time is called Metastable state.

The energy state whose life time is of about  $10^{-6}$  to  $10^{-3}$  sec is called Metastable state.

# Active Medium

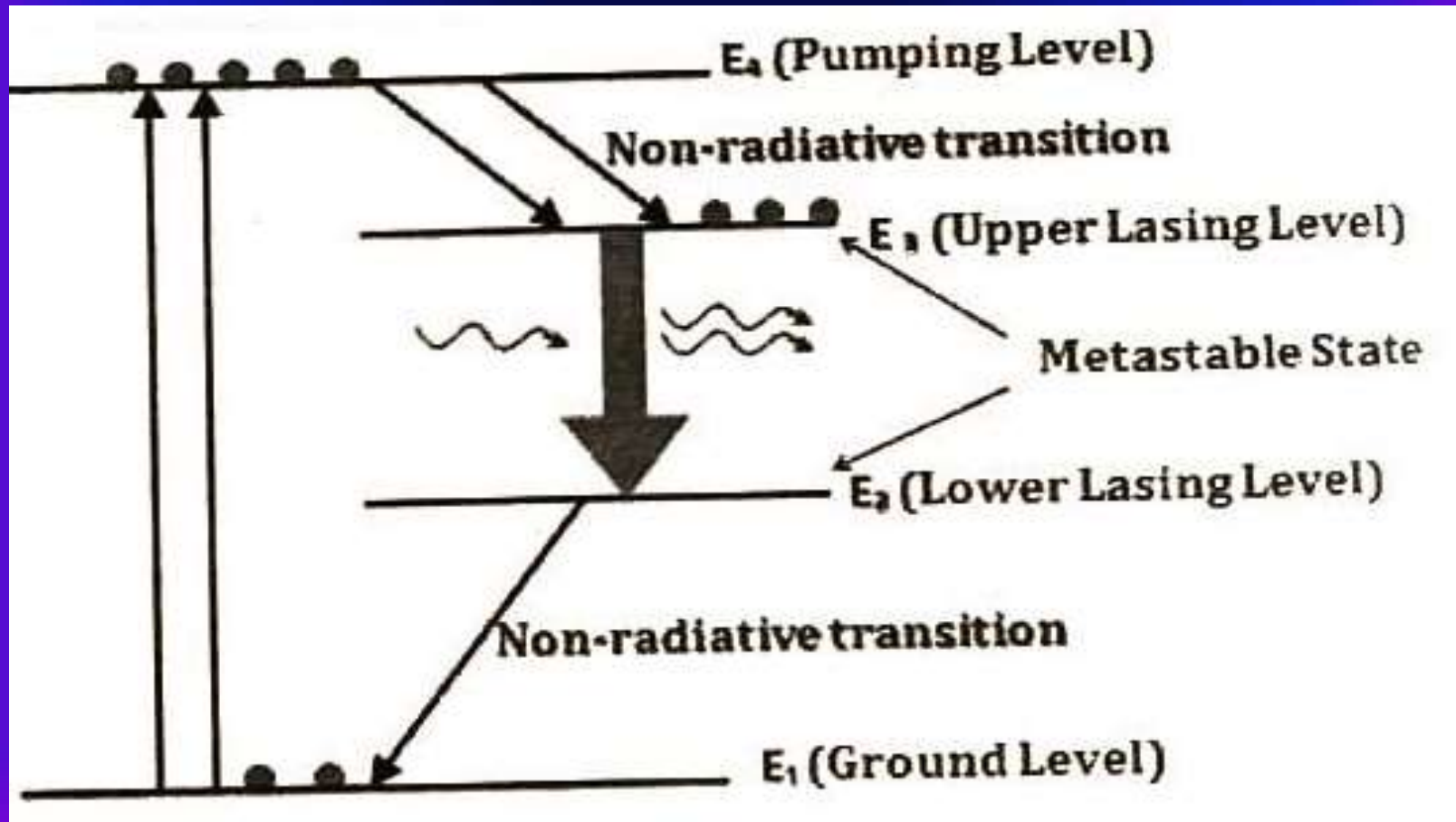
- A medium in which light amplification takes place is known as active medium.
- The atoms of particular species which cause lasing action are called active centers.
- An active medium is a medium which, when excited state reaches the state of population inversion and promotes stimulated emission leading to light amplification

# THREE LEVEL PUMPING SCHEME



$$E_1 < E_2 < E_3$$

# FOUR LEVEL PUMPING SCHEME



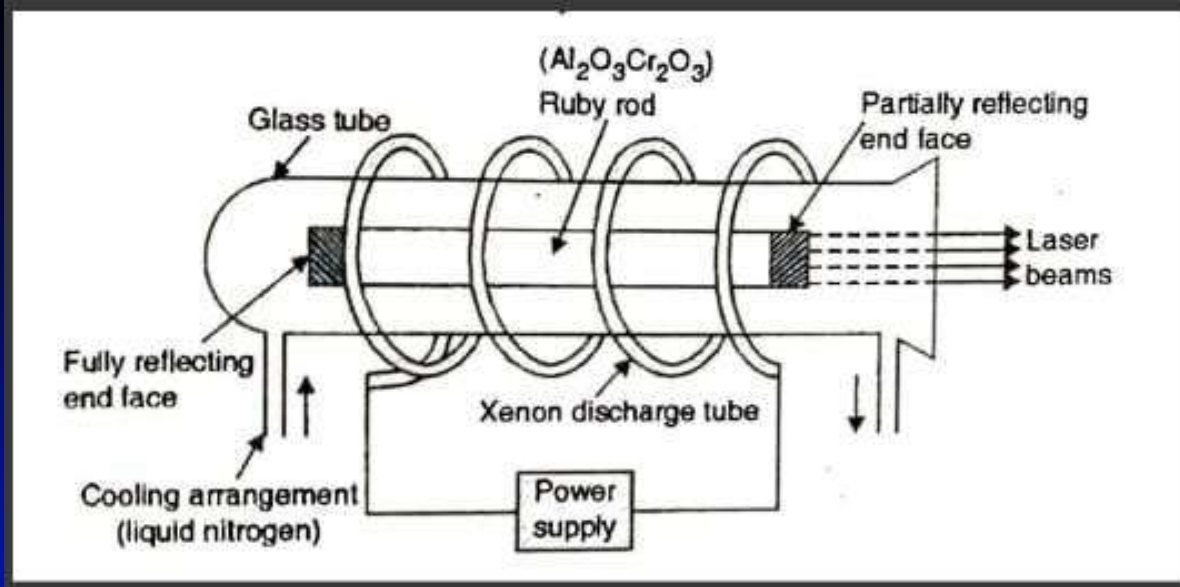
# TYPES OF LASER

- Ruby Laser
- He-Ne Laser
- Semiconductor Laser

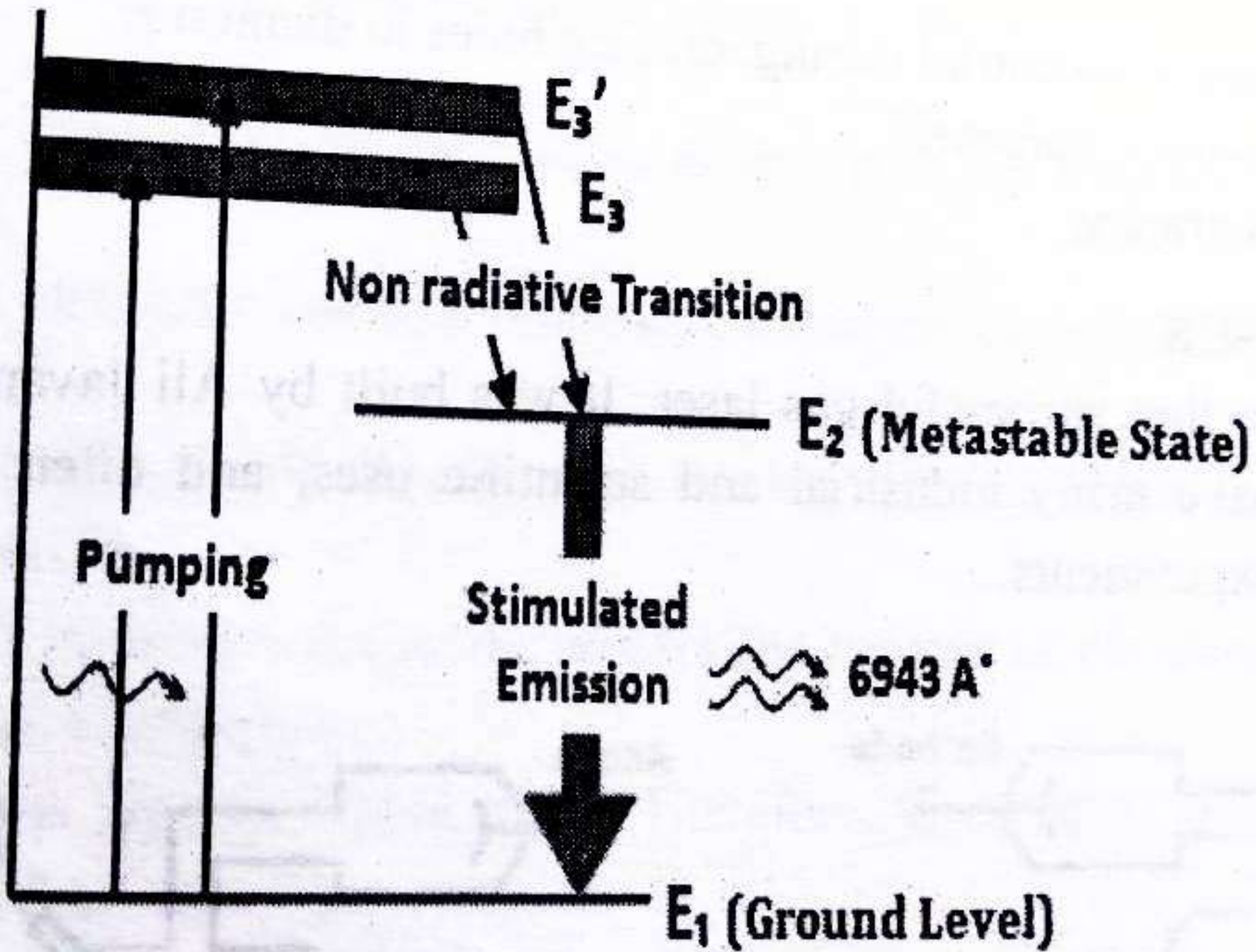


# RUBY LASER

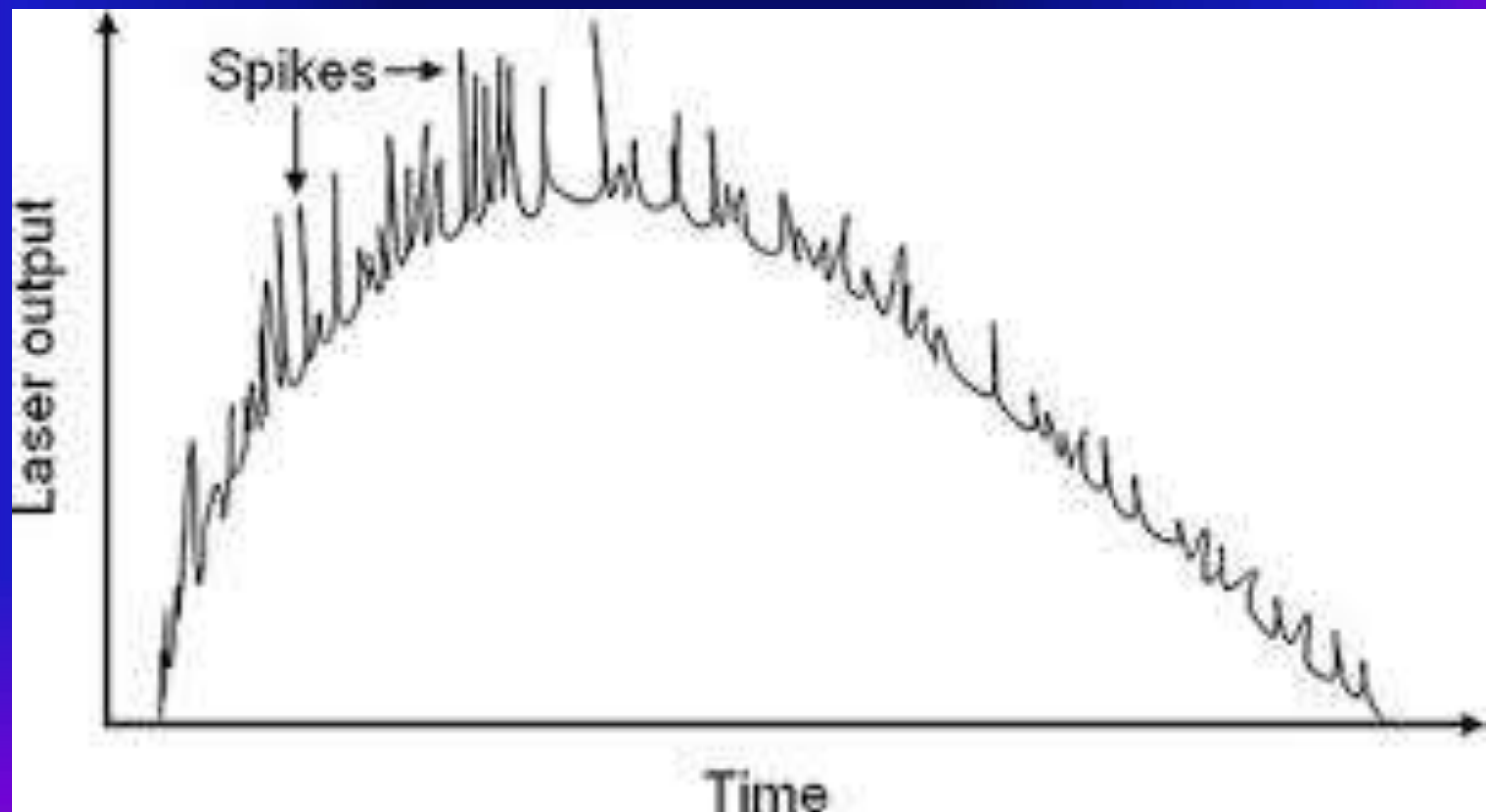
- T. H. Maiman - 1960.
- Solid State Laser.
- Ruby -  $\text{Al}_2\text{O}_3$  containing about 0.05% of Chromium atoms.



- Ruby crystal - Cylindrical rod - About 4 cm in length and 1 cm diameter.
- End faces are polished and flat - One end fully reflecting - another end partially reflecting.
- Ruby rod is surrounded by Xenon flash lamp - provides pumping.
- A cooling arrangement is provided to keep the experimental set up at normal temperature.

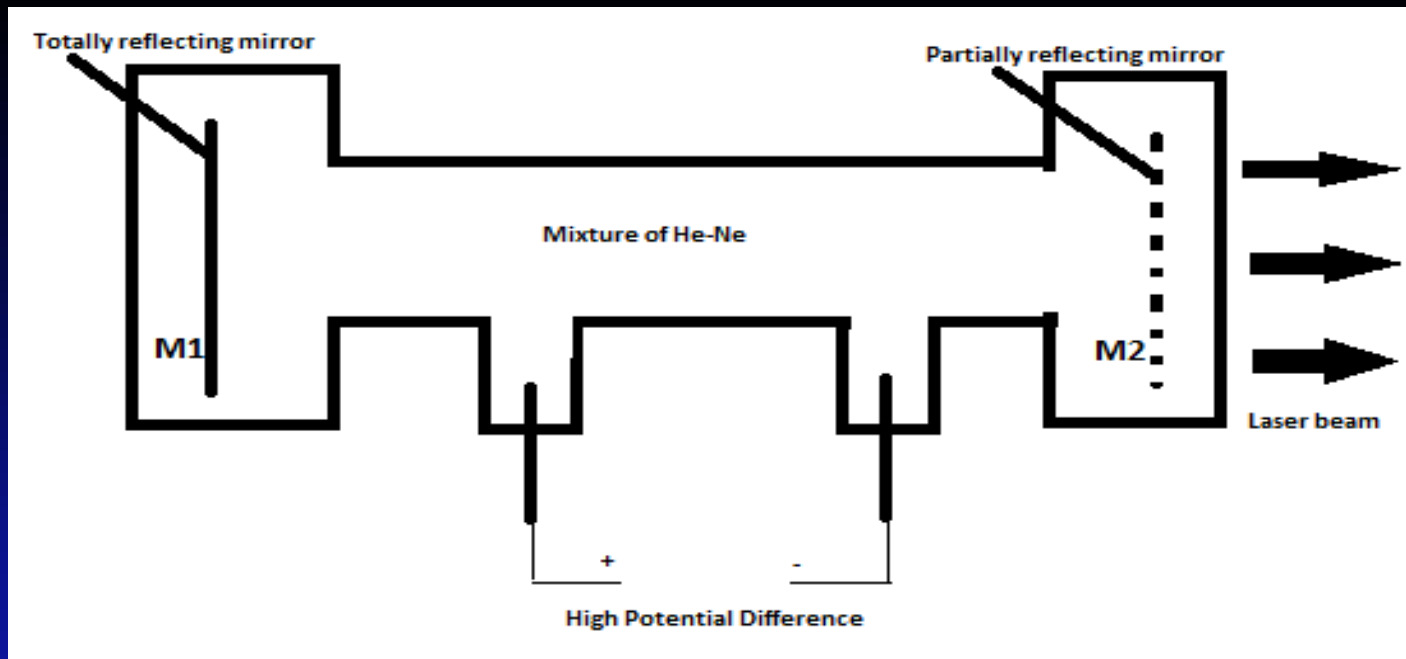


# SPIKING BEHAVIOUR OF RUBY LASER

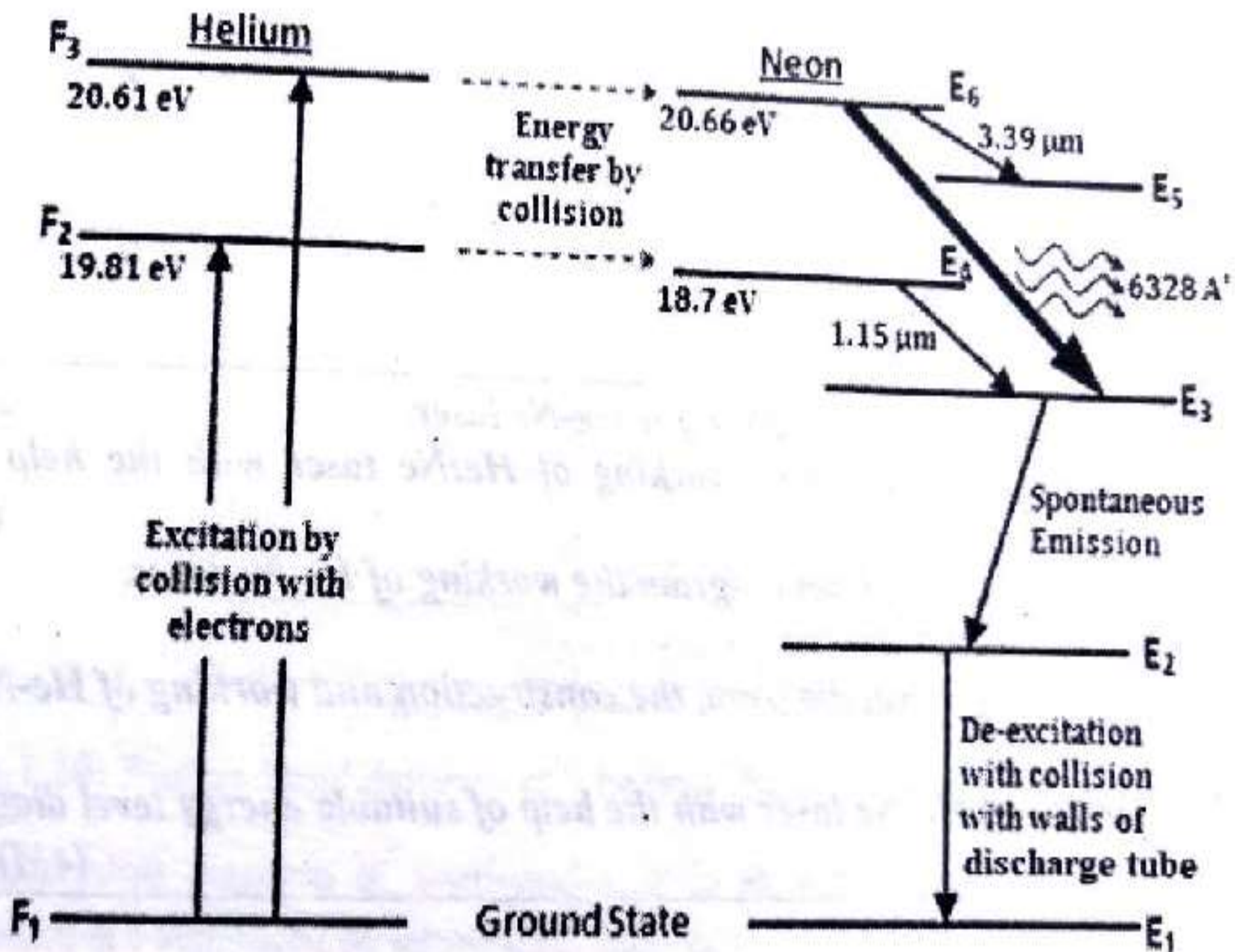


# He-Ne Laser

- Ali Javan - 1961
- Gas Laser
- Mixture of Helium and Neon gases in the ratio 10:1



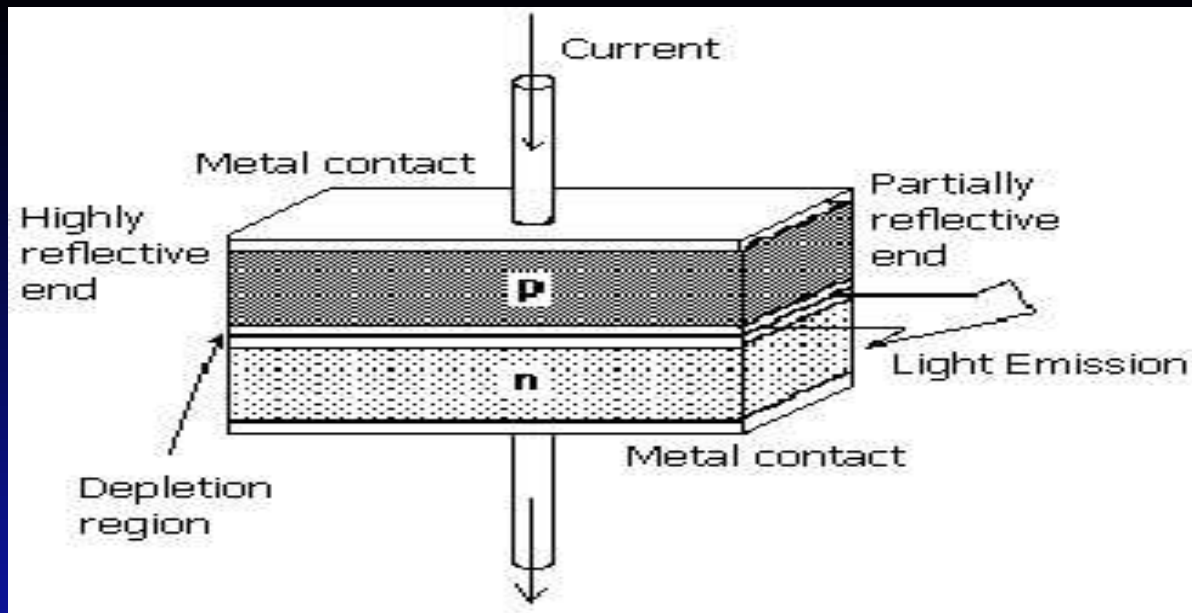
- Long narrow discharge tube about 80 cm long and 1 cm in diameter.
- Helium - 1 mm pressure and Neon - 0.1 mm
- 2 Electrodes
- M1 - Fully reflecting
- M2 - Partially Reflecting



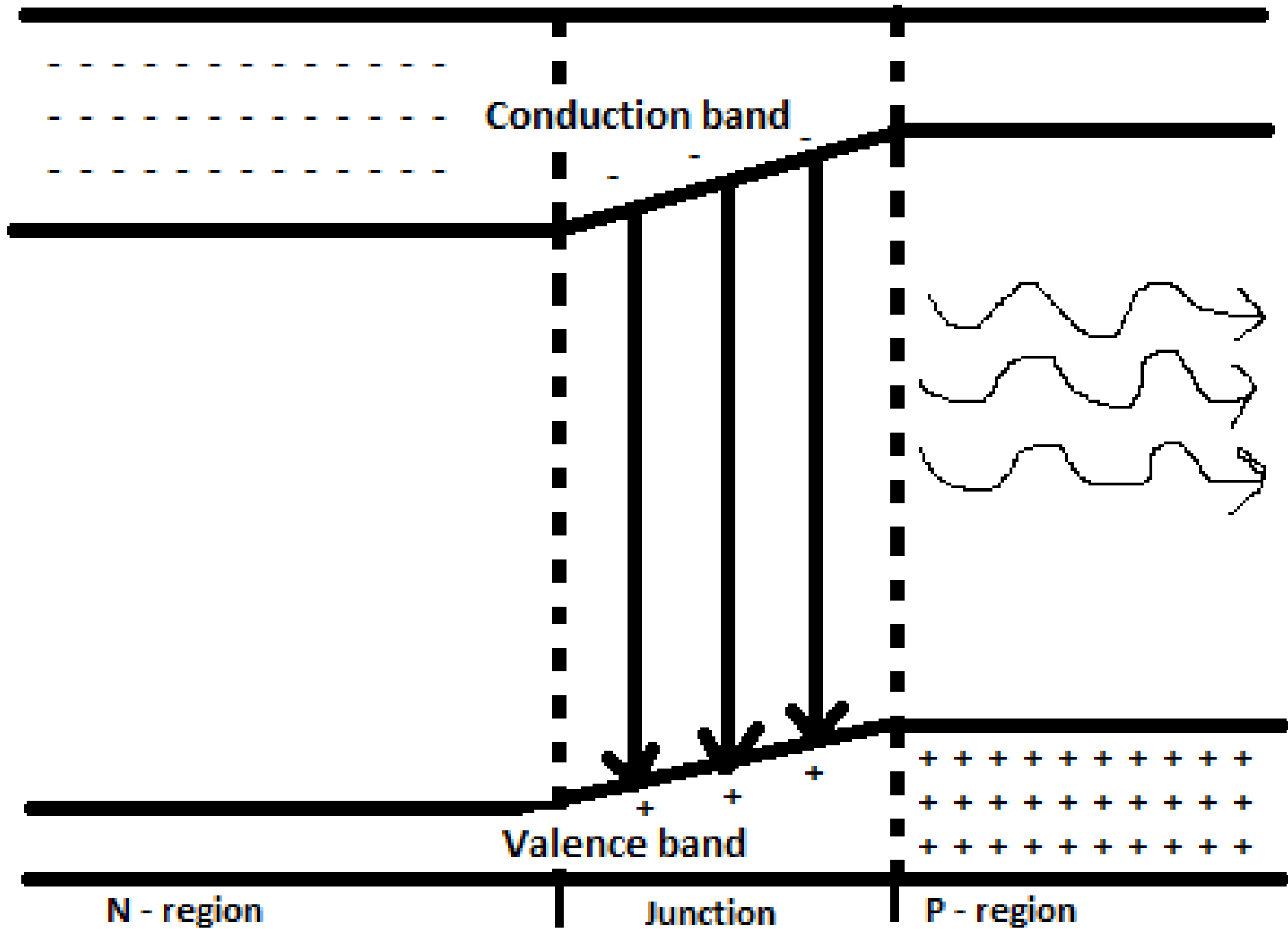


# SEMICONDUCTOR LASER

- R. N. Hall - 1962
- Very small sized
- Similar to transistor - operation like  
LED
- Output Characteristics - Laser



- Extremely small - 1 mm-GaAs
- Junction lies in horizontal plane through the centre
- Top faces - metal contact
- The front and rear faces - polished - parallel to each other
- The other two opposite faces - rough



# APPLICATIONS OF LASER

- Industrial Applications

Welding

Drilling

Cutting

- Medical Applications

Bloodless cancer surgery

Eye surgery

Plastic surgery

- **Electrical Industries**

Bar-code reader

Compact Disc

- **Military**

War weapon

Destroy enemy air-crafts and missiles

Detection and ranging RADAR

- **Communication**

Sending more channels simultaneously

Signal cannot be tapped

More data can be sent

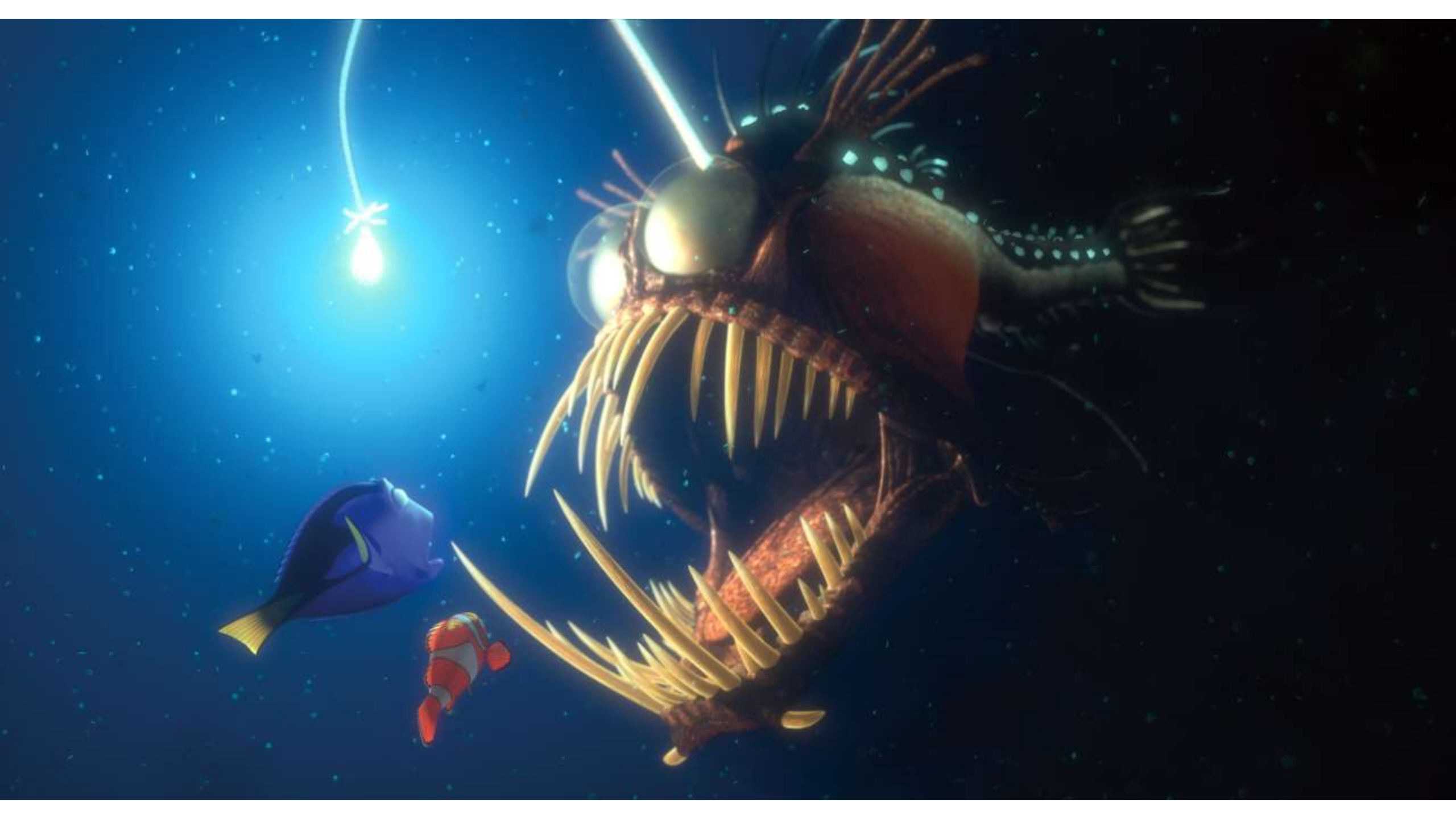
THANK  
YOU

## **UNIT III**

**12 Periods**

1. Marine Ecosystem, Salinity and density of Sea water, Continental shelf.
2. Adaptations of deep sea organisms.
3. Coral reefs, Sea weeds.
4. Nutrient Cycles in Sea/ Ocean -Nitrogen, Sulphur and Phosphorous.





Deep sea .....?

Usually lightless sea bottom is referred to as deep sea, i.e., from lower limit of littoral zone (200 meters deep) to the ocean floor.

## **Physical Characteristics of deep sea:**

- Environmental factors in deep sea are uniform from ocean to ocean and from season to season.
- Sea bottom is smooth in physical characters. Therefore, deep-sea creatures of different oceans have a convergent type of adaptation.

## **Characteristics of Deep Sea:**

### **i. Temperature:**

Below 3000 ft. the temperature is about 37° F or less. In the great ‘deeps’ the water is ice cold, averaging about 32° F. There is no diurnal and seasonal fluctuation.

### **ii. Quiescence:**

Below the limit of disturbance caused by the storm wave, i.e., about 600 ft. and below the average depth of the tidal action all movements of sea wave are exceedingly slow.

### **iii. Darkness:**

The distance to which light penetrates varies with the angles of the sun rays and the clarity of the water. Generally below 1200 ft. light does not penetrate. So there is endless darkness in deep-sea.

#### **iv. Pressure:**

The atmospheric pressure at sea level is about 7 kg/sq inch. This increases enormously to about 1 ton/sq inch for every 6000 ft. Therefore, in greater depth, the pressure is unbelievably high.

#### **v. Green Plants:**

Beyond the light zone green plants are totally absent, i.e., ecologically, no producer is present in deep-sea.

#### **vi. Other Characters:**

Deep-sea water possesses uniform salinity (3.5 – 3.7%), as no external factors can affect its water qualities. Oxygen content is comparatively low (3.29 – 5.9 c.c./litre of water), because there are no producers, which generally contribute oxygen during day-time.

## **vii. Sea Floor:**

The ocean floor generally is a vast undulating plain with occasional volcanic and other elevations. The floor of the sea is usually carpeted with mass of land material and organic materials. Organic materials are either excretory and secretory products or carcasses of the upper inhabitants. The organic remains are known collectively as oozes.

## **viii. Food Supply:**

Oozes constitute the sole food supply to the depth, i.e., dead organisms of upper level, when die, come down to the deep sea and provide food for the deep-sea organisms. Sometimes decomposers, like bacteria and fungus are also used as food. So deep-sea animals are either oozivorous or carnivorous due to lack of vegetation.

## **Origin of Deep-sea Fauna:**

All phyla of animals are represented in the deep-sea fauna. None of the deep-sea form is the product of the locally evolved race, but they are simply adapted migrants from the lesser depth.

In response to physical conditions of deep sea, modifications have occurred in such fauna. Ancient zoological forms are rare in deep-sea and this indicates that deep-sea fauna includes recent forms only.

## **Adaptive Characters of Deep-sea Animals:**

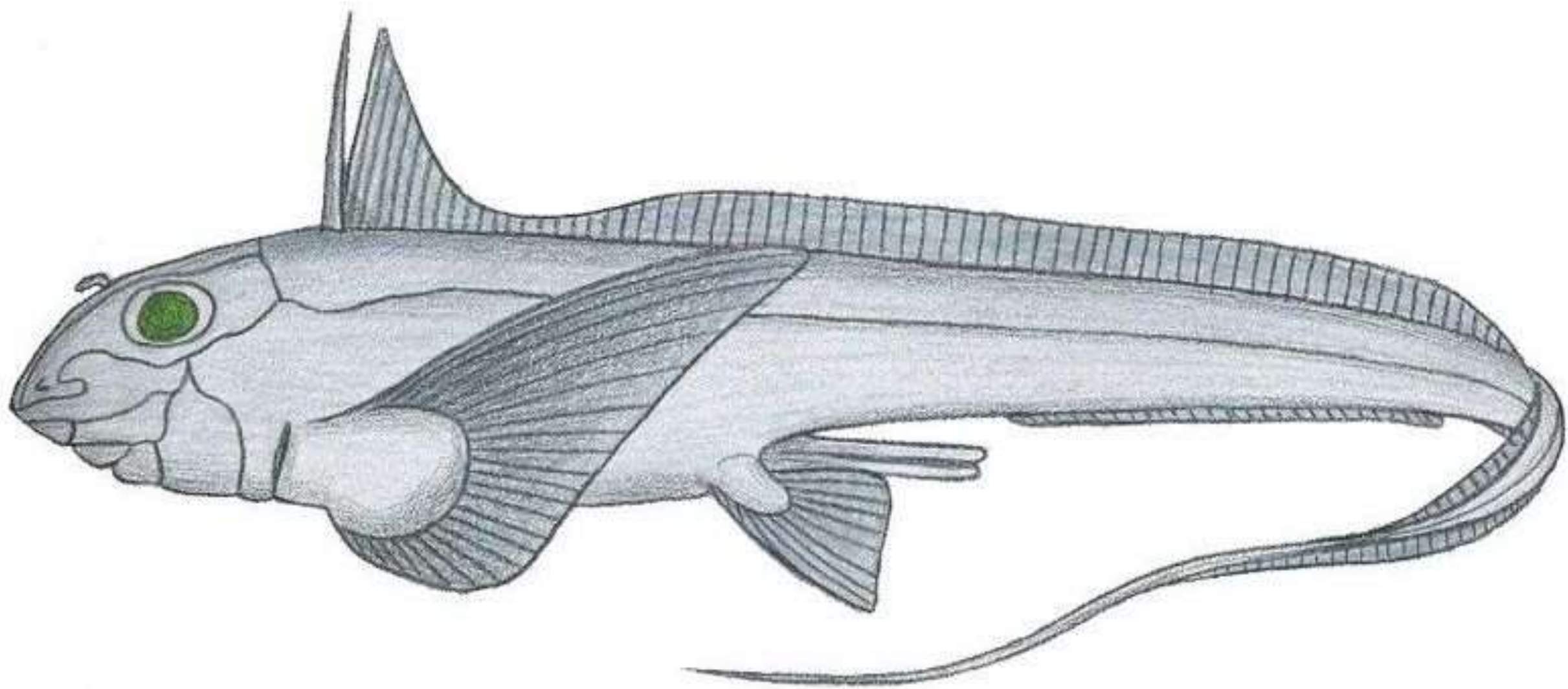
### **i. Consistency of Animals:**

The animals are frail and weak and their body is thin and flabby.

Vertebrates possess **un-calcified or weakly calcified skeleton**. It is due to inability to accumulate calcium within the tissues in absence of sunlight. Totally un-calcified skeleton is found in Chimaera.







## **ii. Body Contour:**

Deep-sea fishes are slender and delicate. In many species, tail becomes a long whip like caudal filament, e.g., Chimaera, Macro pharynx etc. Body is compressed either laterally or dorsoventrally, giving the body a ribbon like shape. In case of dorsoventrally compressed body, both eyes comes to lie side by side. It is supposed that dorsoventrally compressed body appears due to high pressure on the body surface.

### **iii. Color:**

As a rule there are simplified colours among deep-sea animals. Usual colours found are red, brown, gray or black. Standard aquatic colouration is black back and silvery belly. Black back hides the deep-sea animal from its upper predators. Because upper predators cannot see a black animal in black background. Similarly, silvery belly helps the animal to escape from the eyes of underwater preys. *Macrurus filicanda* exhibits a black belly and silvery top; which is exception to the standard coloration.

### **iv. Vision:**

In a completely dark atmosphere, eye has no function. So some deep-sea fishes are blind. Others have either telescopic eyes or bear eyes like concave mirrors.

#### **v. Tactile Organs:**

As vision becomes nil, tactile organs are highly developed. Long feelers and slender attenuations of the fins act as a tactile organ.

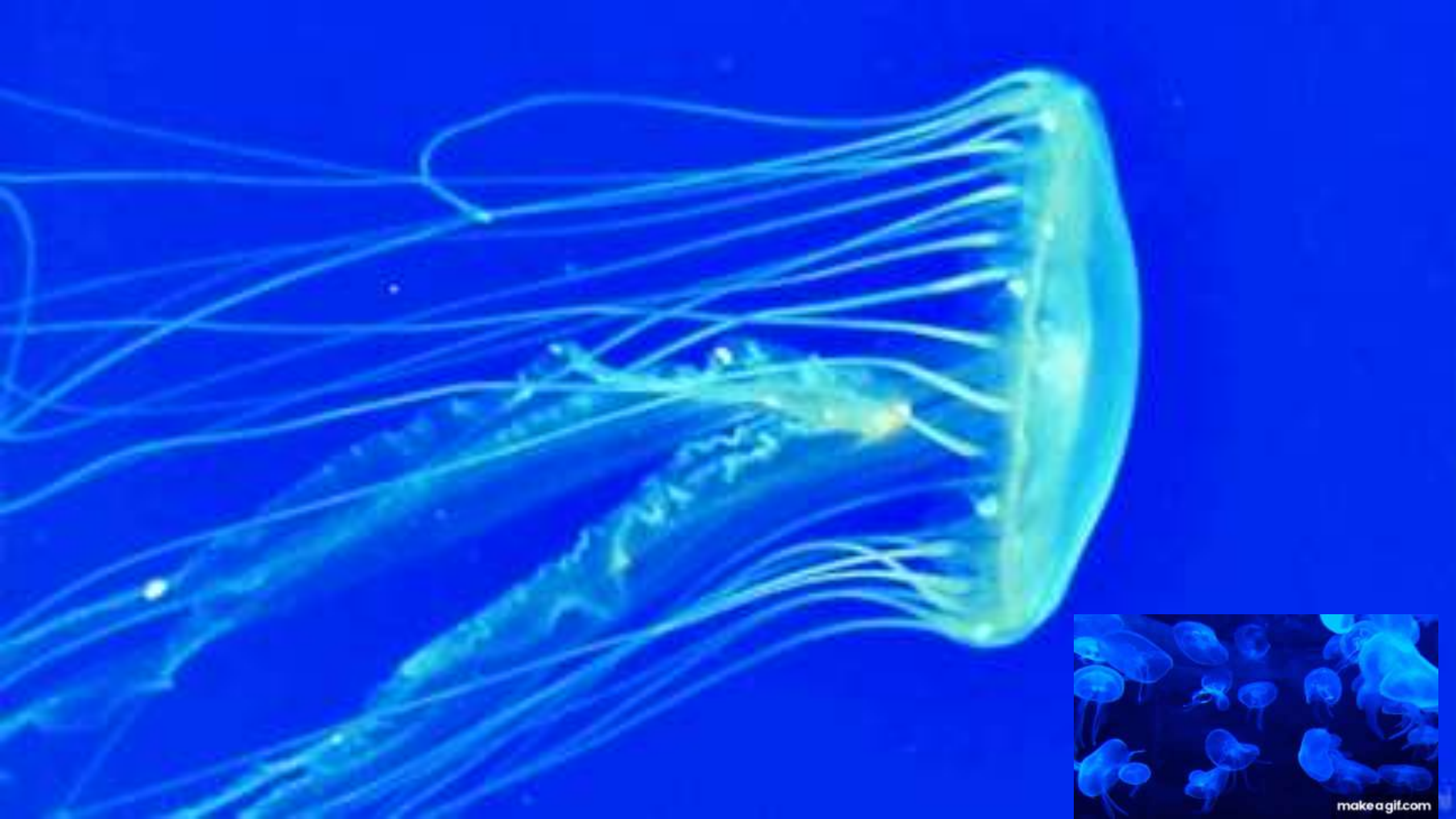
#### **vi. Luminescence:**

The light producing function or luminescence is a common, phenomenon in almost all deep-sea fauna. Luminescent bodies may be round or elliptical in shape, shining mother of pearl coloured body, embedded in the skin at the side of the body and tail.

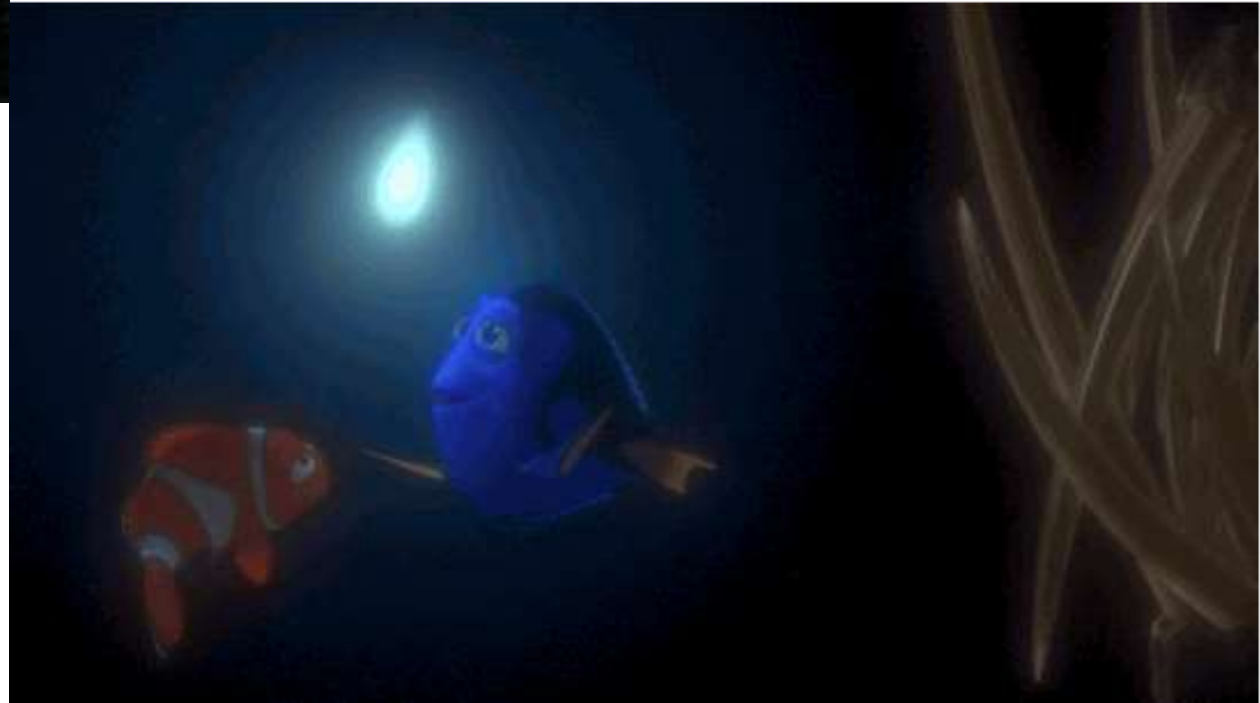
#### **vii. Weak Jaws:**

Many deep-sea fishes live on decaying oozes and they generally loose their powers of mastication.













### **viii. Reproduction and Care of Young:**

1. There are various ways of carrying the young's among deep-sea fauna. These animals lay fewer eggs with much yolk, and hatch at an advanced stage of development. In ice cold water, time for embryonic development increases.
2. So eggs are laid with much yolk. Some are even viviparous and produce young ones in large number. Uncared eggs in water results in predation, which forces some of the deep-sea animals to become viviparous.
3. Care for young is very common. Deep-sea environment exhibits changelessness or to some extent change occur very slowly. There is nothing to mark the day and night, there is no sequence of seasons and same condition prevails throughout the year.

# Dairy Farming

- Dairy farming has been an important part of the agricultural scenario for thousands of years.
- India being a predominantly agrarian economy has about 70 per cent of its population living in villages, where livestock play a crucial role in the socio-economic life.
- Livestock provide high-quality foods such as milk, cheese, butter, ghee, etc. India is not only one of the top producers of milk in the world, but also the largest consumer of milk and milk products in the world.
- Due to the shortfall in supply, we have to import significant amounts of milk products to meet internal demand.

- Agriculture and animal husbandry have a symbiotic relationship, in which the agricultural sector provides feed and fodder for the livestock and animals provide milk, manure and draught power for various agricultural operations.
- Dairy sector is instrumental in bringing socio-economic transformation in India.
- It has created a lot of employment opportunities and also provides improved nutritional benefits.

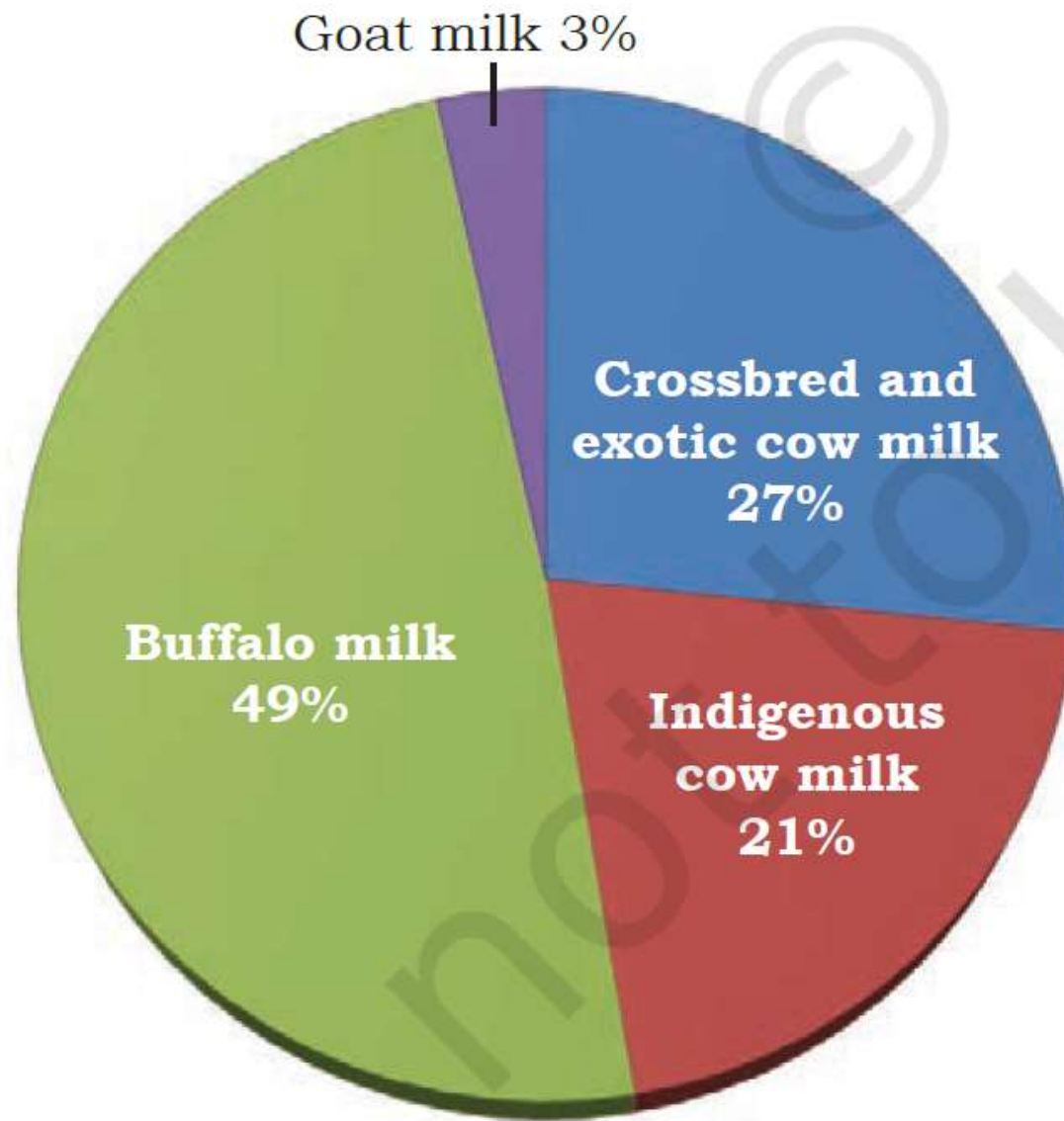
- Animal husbandry is a major sub-sector of agriculture sector and contributes about 28.6 per cent to the agricultural value output (Annual Report 2017–18, Department of Animal Husbandry, Dairying and Fisheries, Government of India).
- The growth rate of 6.27 per cent and 6.37 per cent during 2015–16 and 2016–17, respectively in the livestock sub-sector is much faster than the overall 0.7 per cent and 4.9 per cent growth rate of agriculture and allied sector during the same period (Economic Survey, 2016–17).
- The statistics indicate that there is a lot of employment potential for entrepreneurial activities in the dairy sector.

## Scope for Dairy Farming and its National Importance:

The total milk production in the country for the year 2021-2022 was estimated at 209.96 million tonnes.

there is a tremendous scope/potential for increasing the milk production. The population of breeding cows and buffaloes in milk over 3 years of age was 62.6 million and 42.4 million, respectively (1992 census).

LIVESTOCK POPULATION IN INDIA BY SPECIES (MILLION NUMBERS)														
Species	1951	1956	1961	1966	1972	1977	1982	1987	1992	1997	2003	2007	2012	2019
Cattle	155.3	158.7	175.6	176.2	178.3	180.0	192.5	199.7	204.6	198.9	185.2	199.1	190.9	192.5
Adult Female Cattle	54.4	47.3	51.0	51.8	53.4	54.6	59.2	62.1	64.4	64.4	64.5	73.0	76.7	81.4
Buffalo	43.4	44.9	51.2	53.0	57.4	62.0	69.8	76.0	84.2	89.9	97.9	105.3	108.7	109.9
Adult Female Buffalo	21.0	21.7	24.3	25.4	28.6	31.3	32.5	39.1	43.8	46.8	51.0	54.5	56.6	55.0
Total Bovines	198.7	203.6	226.8	229.2	235.7	242.0	262.2	275.7	288.8	288.8	283.1	304.4	299.6	302.3



*Fig. 1.1: Milk production from dairy animals in India*

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- Dairying is an important source of subsidiary income to small/marginal farmers and agricultural labourers.
- The manure from animals provides a good source of organic matter for improving soil fertility and crop yields.
- The gobar gas from the dung is used as fuel for domestic purposes as also for running engines for drawing water from well.
- The surplus fodder and agricultural by-products are gainfully utilised for feeding the animals.

- The demand for milk is constantly increasing in cities as well as small towns and rural areas. The factors influencing this increased demand are — rapid increase in population, spread of education, growing nutritional awareness and improved purchasing power of consumers.
- Dairy farming in India has evolved from just an agrarian way of life to a professionally managed industry. A large number of rural families in India are engaged in dairy production, for whom this is an important source of secondary income.
- In India, raw milk is perceived to be fresh by most consumers and has a large market. Conventional dietary habits in India account for about 60 per cent of milk consumption in liquid form, and the remaining in the form of ghee, cheese, curd, paneer, ice cream, dairy whiteners and traditional sweets.

- Dairying provides a source of daily income with a relatively low level of risk.
- Most of the dairy farmers in India raise animals at a small scale in traditional ways.
- The productivity of these farmers can be enhanced if they run their business in a scientific manner.
- Most of such farmers are not aware of the modern methods of dairy farming.
- As a result, some farmers lose their investment instead of making profit. To ensure maximum production and profits from dairy farming, it is essential that these farmers adopt proper business plans and good dairy management practices

## **Management of Dairy:**

The scheme for dairy, farming should include information on land, livestock markets, availability of water, feeds, fodders, veterinary aid, breeding facilities, marketing aspects, training facilities, experience of the farmer and the type of assistance available from State Government, dairy society/union/federation.

**(A) Technical Feasibility – this would briefly include:**

1. Nearness of the selected area to veterinary, breeding and milk collection centre and the financing bank's branch.
2. Availability of good quality animals in nearby livestock market.
3. Availability of training facilities.
4. Availability of good grazing ground/lands.
5. Green/dry fodder, concentrate feed, medicines etc.
6. Availability of veterinary aid/breeding centres and milk marketing facilities near the scheme area.

**(B) Economic Viability – this would briefly include:**

1. Cost of for feeds and fodders, veterinary aid, breeding of animals, insurance, labour and other overheads.
2. Output costs i.e. sale price of milk, manure, gunny hags, male/female calves, other miscellaneous items etc.

**Farmers:**

Modern and well established scientific principles, practices and skills should be used to obtain maximum economic benefits from dairy farming.

**Some of the major norms and recommended practices are as follows:**

### **I. Housing:**

1. Construct shed on dry, properly raised ground.
2. Selling of the old animals after 6-7 lactations.

### **II. Feeding of Milch Animals:**

1. Feeding the animals with best feeds and fodders.
2. Giving adequate green fodder in the ration.

### **III. Milking of Animals:**

1. Milking the animals two to three times a day.

### **IV. Protection against Diseases:**

1. Be on the alert for signs of illness such as reduced feed intake, fever, abnormal discharge or unusual behavior.



## **V. Breeding Care:**

Animal should be closely observed and keep specific record of its coming in heat, duration of heat, insemination, conception and calving.

## **VI. Care during Pregnancy:**

Give special attention to pregnant cows two months before calving by providing adequate space, feed, water etc.

## **VII. Marketing of Milk:**

1. Marketing milk immediately after it is drawn, keeping the time between production and marketing of the milk to the minimum.
2. Production of milk produces for better storage to give more returns

## **VIII. Care of Calves:**

1. Taking care of new born calf.

## Management of Dairy Farm

- Management is an art and science and it is managerial capacity that can convert the resources into return.
- Due to lack of awareness, management is ignored and this hampers the productivity of dairy animals.
- Dairy owners should plan into action under strict supervision. This would increase the production efficiency.

Management Practices need to be considered in various areas of dairying :

Breeding

Feeding

Shelter Management

Health Care

# Breeding Management in Dairy

## Two Strategies:

### 1. Selection of Genetically Superior Animals.

- Free from diseases
- Having yearly calving from the records
- Having faster growth rate after birth
- Better feed conversion efficiency

## **2. Use of Artificial Insemination Technology**

This is a most successful method for breed improvement and development.

Bull should be true type and progeny of high yielders.

It should be practiced at proper time i.e. 12 to 18 hrs after onset of heat.

Some major factors:

Bringing Genetic Improvement

Selective Breeding and Crossbreeding improving milk production potential of milk animals.

# Feeding Management

Scientific feeding and its application is important factor.

Cost of feeds and fodder constitutes 65 to 70% of total cost of livestock production.

Shortage of food and fodder can be the major reason of low animal productivity.

Crop sources and grasses are major sources of roughage. Being poor nutritive value, They cannot meet nutrient requirement.

Treatment with urea improves nutritive value i.e. digestibility.

Balanced feeding should be practiced (Dry, green fodder and concentrates) to keep the animal in healthy state and will ultimately lead to higher milk production.

## Concentrate feed:

- 20-25 parts of oil cakes
- 25-35 parts of cereal grains
- 10-25 parts of wheat rice bran
- 5-20 parts of dal
- 2% Minerals
- 1% Common Salt





Green fodder is essential in feeding for economic milk production and it is a cheap source of nutrients.

Proper ratio of green dry fodder should be 4:1.

Giving mineral mixture is integral part of successful herd management program.

Unconventional feed used during scarcity is *Babul tree* leaves and pods, Salseed cake, neemseed cake, fruit and vegetable wastes can be used.

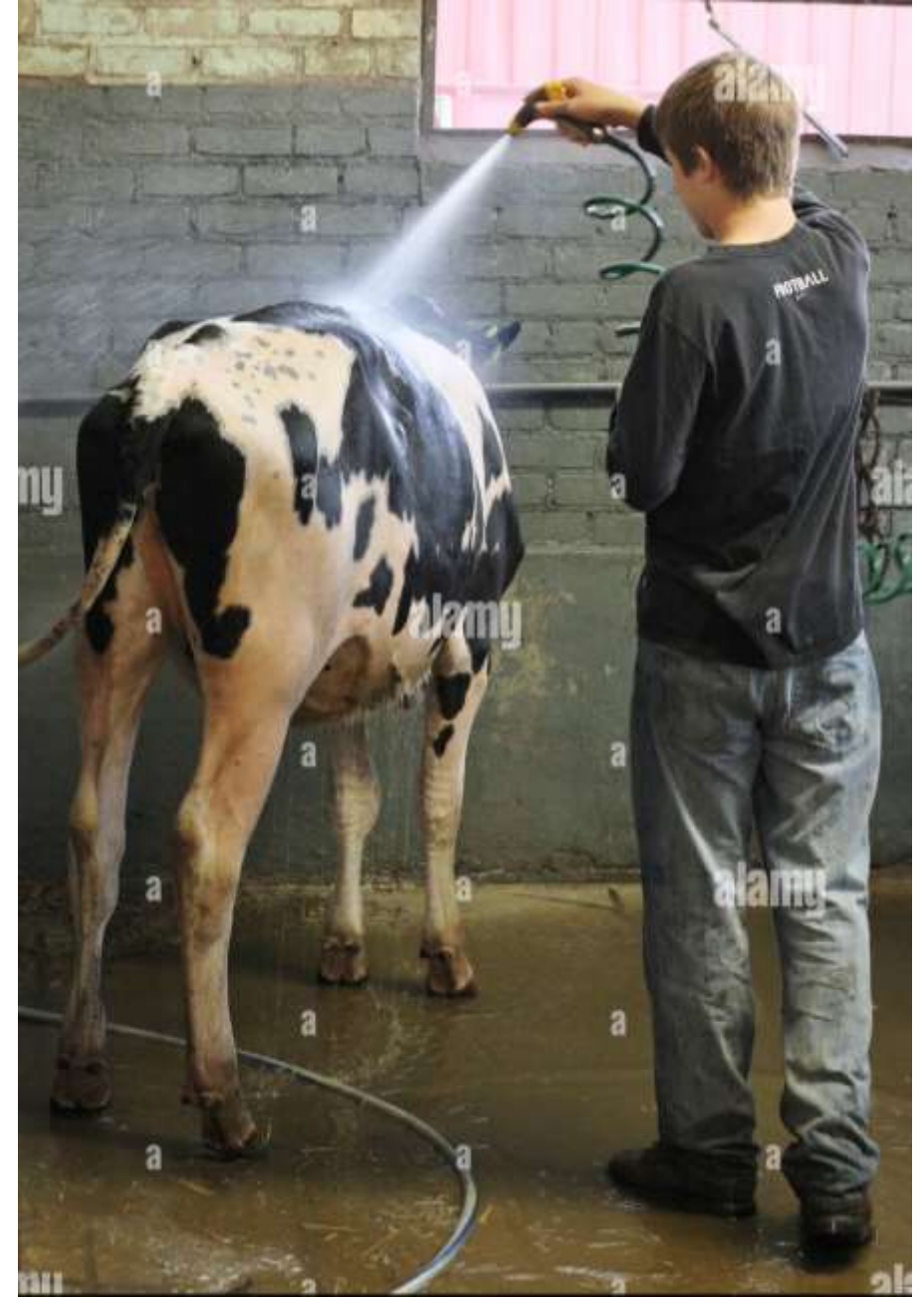
Quality and Quantity of Water is important. Because Milk constitutes about 83.87 % of water.

3 kg of water is required for 1 kg of milk.

3 to 4 times a day supply is essential.

## Shelter Management:

- Cattle shed should be located at a high, well drained land.
- Floor should be hard and non slippery and easy to clean and dry with suitable drainage system and ventilation.
- Cleaning, brushing and washing of animals should be done regularly.



- Animals should be provided with fresh clean, cool and odourless water.
- Moderate exercise should be given daily.
- Hygiene of animal, cleaning of milk barn, cleanliness of milk should be followed which significantly improve quality and safety of milk.
- All manure should be removed daily and disposed into pit for decomposition.
- It is beneficial if dairy owner keep some record regarding accounts of milk production, reproduction, sale and purchase of animals.

## Health Care Management:

- Healthy animals are vital for milk production
- Detection of symptoms is important.
- Isolate the infected animals and should not come into the contact with other animals.
- Treatment of sick animals should be done by veterinarian.
- Vaccination is important because prevention is better than care.
- Timely vaccination should be given.
- Deworming and spraying should be done to keep animals free from ecto and endoparasites.

# **ARTIFICIAL INSEMINATION**

**Artificial insemination is the technique in which semen with living sperms is collected from the male and introduced into female reproductive tract at proper time with the help of instruments.**

This has been found to result in a normal offspring. In this process, the semen is inseminated into the female by placing a portion of it either in a collected or diluted form into the cervix or uterus by mechanical methods at the proper time and under most hygienic conditions.

The first scientific research in artificial insemination of domestic animals was performed on dogs in 1780 by the Italian scientist, Lazanno Spalbanzani.

His experiments proved that the fertilizing power reside in the spermatozoa and not in the liquid portion of semen. Few further studies under research station conditions helped this technique to be used commercially all over the world including India.

Artificial insemination is not merely a novel method of bringing about impregnation in females. Instead, it is a powerful tool mostly employed for livestock improvement. In artificial insemination, the germplasm of the bulls of superior quality can be effectively utilized with the least regard for their location in faraway places. By adoption of artificial insemination, there would be considerable reduction in both genital and non-genital diseases in the farm stock.

## Symptoms of Heat

- The animal will be excited condition. The animal will be in restlessness and nervousness.
- The animal will bellow frequently.
- The animal will reduce the intake of feed.
- Peculiar movement of limbo sacral region will be observed.
- The animals which are in heat will lick other animals and smelling other animals.
- The animals will try to mount other animals
- The animals will standstill when another animal try to mount. This period is known as standing heat. This extends for 14-16 hours.



- Frequent maturation (urination) will be observed.
- Clear mucous discharge will be seen from the vulva, sometimes it will be string like the mucous will be seen stick to the near the pasts of valva.
- Swelling of the vulva will be seen. Congestion and hyperemia of membrane.
- The tail will be in raised position.
- Milk production will be slightly decreased
- On Palpation, uterus will be turgid and the cervix will be opened.

## Advantages of Artificial Insemination

- There is no need of maintenance of breeding bull for a herd; hence the cost of maintenance of breeding bull is saved.
- It prevents the spread of certain diseases and sterility due to genital diseases': contagious abortion, vibriosis.
- By regular examination of semen after collection and frequent checking on fertility make, early detection of inferior males and better breeding efficiency is ensured.
- The progeny testing can be done at an early age.
- The semen of a desired size can be used even after the death of that particular sire.

- The semen collected can be taken to the urban areas or rural areas for insemination
- It makes possible the mating of animals with great differences in size without injury to either of the animal.
- It is helpful to inseminate the animals that refuse to stand or accept the male at the time of oestrus.
- It helps in maintaining the accurate breeding and cawing records.
- It increases the rate of conception
- Old, heavy and injured sires can be used.

## Disadvantages of AI

- Requires well-trained operations and special equipment.
- Requires more time than natural services.
- Improper cleaning of instruments and in sanitary conditions may lead to lower fertility.
- If the bull is not properly tested, the spreading of genital diseases will be increased.
- Necessitates the knowledge of the structure and function of reproduction on the part of operator.

## **SEMEN COLLECTION METHODS AND EVALUATION:**

Various methods of collection of semen have been devised from time to time. The older unsatisfactory methods have gradually replaced by the new modern techniques.

**There are three common methods.**

1. Use of artificial vagina

2. By Electro-stimulation method.

3. By massaging the ampullae of the ductus deferens through rectal wall.

The ideal method of semen collection is use of artificial vagina which is safe for sire and the collector also.

## **ARTIFICIAL VAGINA METHOD**

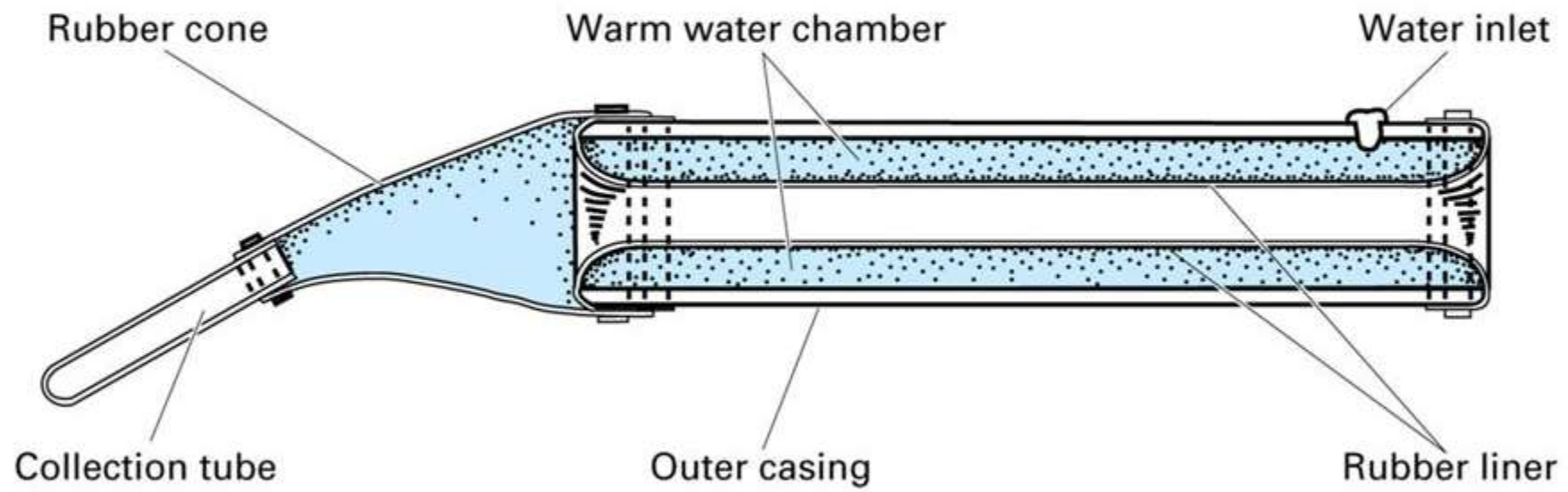
The artificial vagina has the following parts:

- A heavy hard rubber 2" hose, open at both ends with a nozzle for air and water in and outlet.
- Inner sleeve of rubber or rubber liner.
- The semen receiving cone or rubber cone.
- Insulating bag

Before using for semen collection all the parts are washed thoroughly and sterilized properly, and assembled as artificial vagina, the rubber liner is inserted into the hose; inverting both ends back by folding back from either side opening, and fastening with rubber bands. Now the space between the hard rubber hose and inner rubber liner forms a water tight compartment. The nozzle at one end of the hose can be fixed.

  
**Jiangs**







- The water jacket of the Artificial vagina is filled with hot water at a temperature of 45°C (113°F) by opening the nozzle.
- The graduated semen collection tube is fixed to the narrow end of the artificial vagina hose, and fastened by a rubber band.
- The inner side of the rubber liner on the anterior side of the artificial vagina is lubricated with sterile jelly to a length of 3 to 4 inches.

- Air is blown through the nozzle into the water jacket, to create pressure in it, and the same is exerted the rubber linear, to simulate natural vagina.
- The temperature of the artificial vagina is to be checked, at each collection, and it should simulate natural vagina at mounting time.
- If it is too cold ejaculate may not be there after a thrust, or even if ejaculate is there; it may be contaminated with urine, and becomes unfit for use.

## SEMEN COLLECTION METHOD

- The cow or dummy is secured in service area.
- The artificial vagina assembled is held at 45° angle from the direction of penis, and the thrust is that angle.
- The artificial vagina is held with the left hand by a right handed person; and when the bull mounts the cow, the sheath of the bull will be guided by the operator, directing the glans penis into the artificial vagina, and then the bull gives a thrust to ejaculate.
- The operator should exercise care so as not to touch the exposed part of the penis.



**Semen Collection**

- After the bull dismounts, the artificial vagina is taken off from penis and the air vent is opened to release the pressure from the jacket.
- The water from the jacket is also drained by opening the nozzle. This allows the ejaculate to flow from the cone to the semen collection tube.
- The semen collection tube is detached from the cone, plugged with cotton wool, and taken to the laboratory for examination. The rubber cone and the semen collection tube can be protected from external contamination or heat or higher, by covering with an insulation bag with zip.

# SEMEN STORAGE

- The discovery that bull semen could be successfully frozen and stored for indefinite periods has revolutionized AI in cattle.
- In 1949, British scientists discovered that addition of glycerol to the semen extender improved resistance of sperm to freezing. Glycerol acts to remove water from the sperm cell prior to freezing and prevents the formation of cellular ice crystals which would damage the sperm.
- There are two methods of freezing and storing semen: **dry ice and alcohol (-100 degrees F) and liquid nitrogen (-320 degrees F). Liquid nitrogen is preferred because there is no evidence of fertility deterioration with age. Fertility gradually declines in semen stored in dry ice-alcohol.**

Frozen semen can be stored indefinitely if proper temperature is maintained.

**A recent report told of a calf born from frozen semen stored for 16 years.**

Fresh, liquid semen can be successfully stored for 1 to 4 days at 40 degrees F.

Semen is usually stored in glass ampoules. Other methods appear promising, particularly the French-straw.

Several AI organizations have gone to this method exclusively. Artificial coloring is frequently added to semen extenders in order to distinguish one breed from another. Complete identification of the bull is required on each individual semen container.





## **INSEMINATION METHODS**

There are different methods of insemination in different species of animals i.e. **spectrum method, vaginal method and recto vaginal method.**

## RECTO VAGINAL METHOD

- In cattle the safe and best method of insemination is “Recto vaginal method of insemination”. Cow which is in heat is well controlled placing it in a Travis.
- The inseminator will get ready by wearing a plastic apron, gumboots and gloves.
- The semen straw after thawing (keeping the semen straw in warm water for a minute to convert the freeze semen into liquid and the sperms become motile) is loaded in a sterilized A.I. gun and is covered with a plastic sheath.
- The inseminator will insert the gloved left hand into the rectum after applying the soft soap or other lubricant on the glove and back racked the animal, and the hand is further inserted and will catch hold the cervix through rectal wall. The A.I gun loaded with semen straw is passed.



**Travis**



**The A.I. Gun**

## **Recto-vaginal method of insemination**

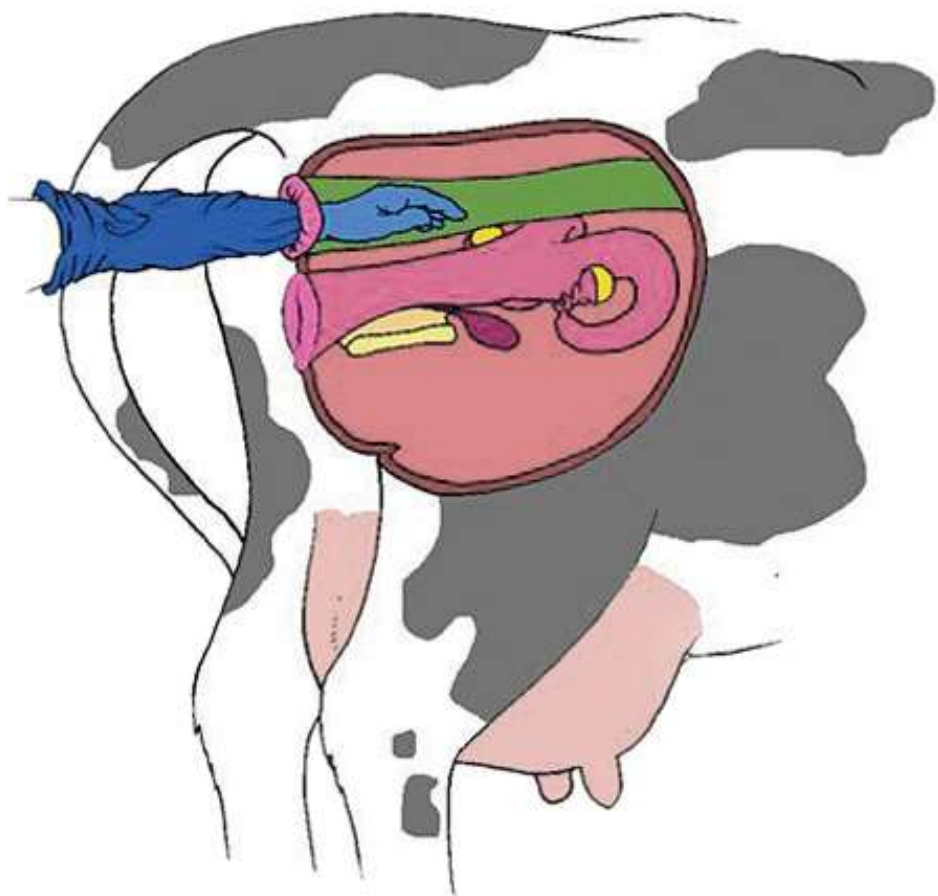
Through the vulva to 'vagina and cervix and observed with the hand in rectum that the A. I. gun reaches the cervix, then the semen is deposited by injecting the gun, and after depositing the semen the gun is removed, the empty straw and sheath are disordered.

## **SPECTRUM METHOD**

In this method spectrum is placed in the vagina of the cow, which provides passage outside to the site of insemination, then inseminating tube is passed through the spectrum and semen is deposited at the cervix insemination method.

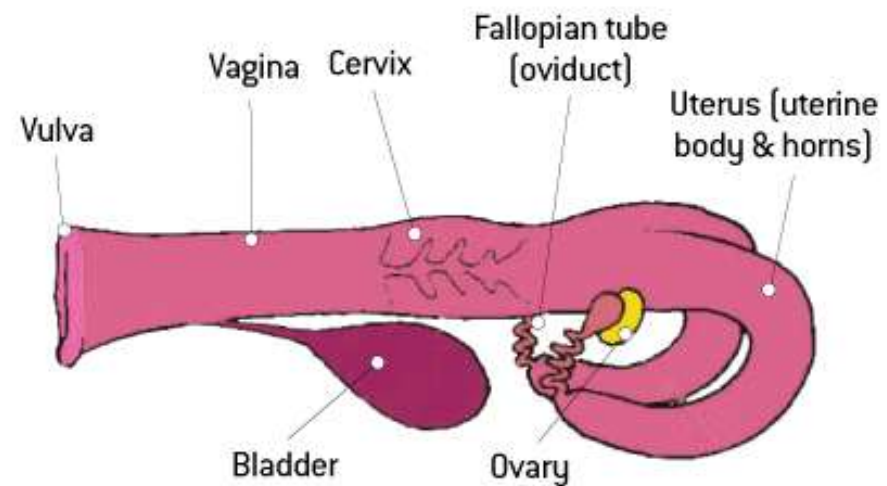
## **VAGINAL METHOD**

Hand is passed through the vagina and the inseminating tube is guided by hand to the site of insemination and semen is deposited. Here there is a risk of contamination and injury of female genitalia.

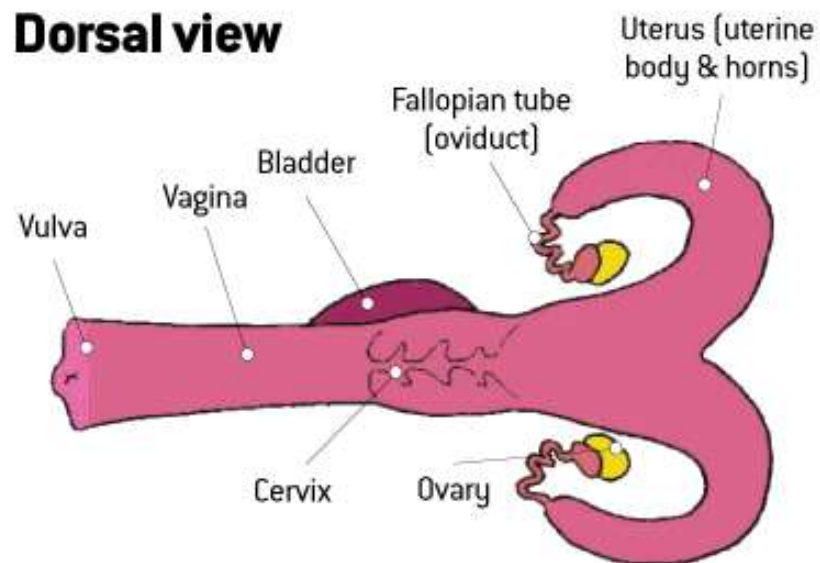


Preparing the cow

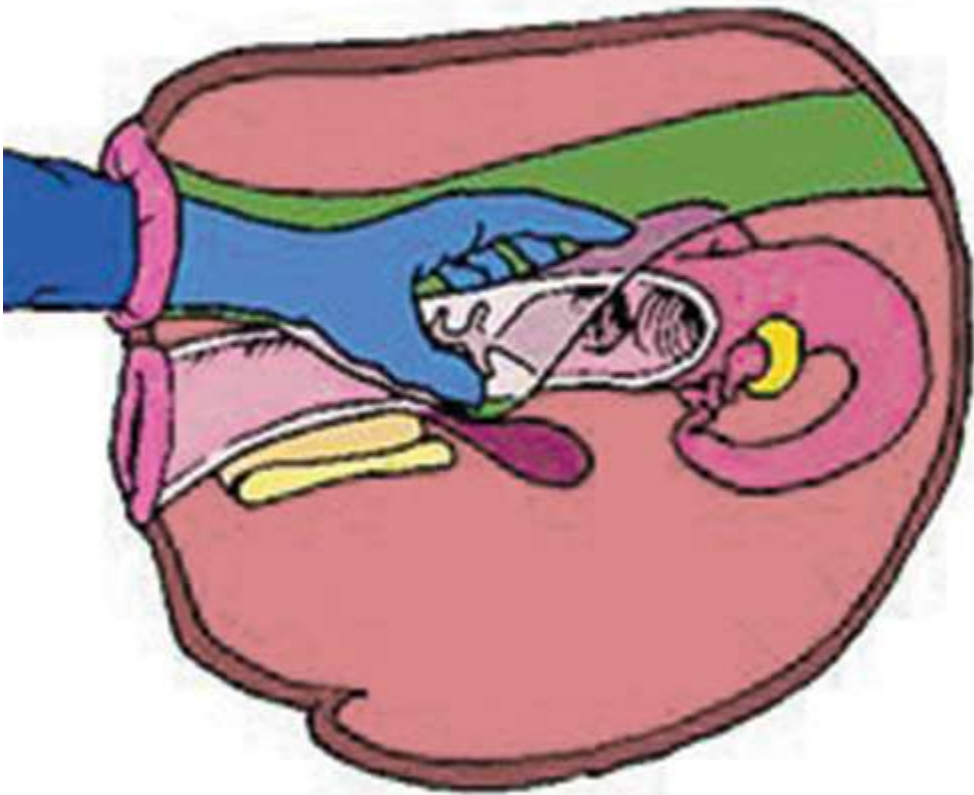
### Lateral view



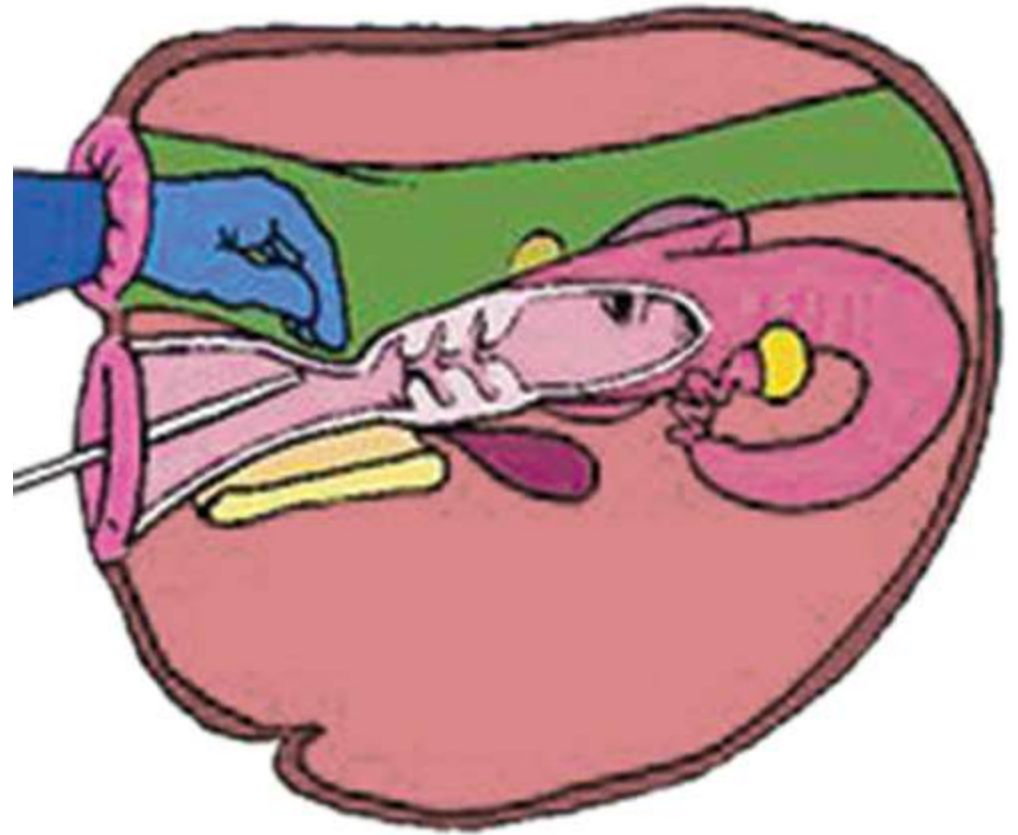
### Dorsal view





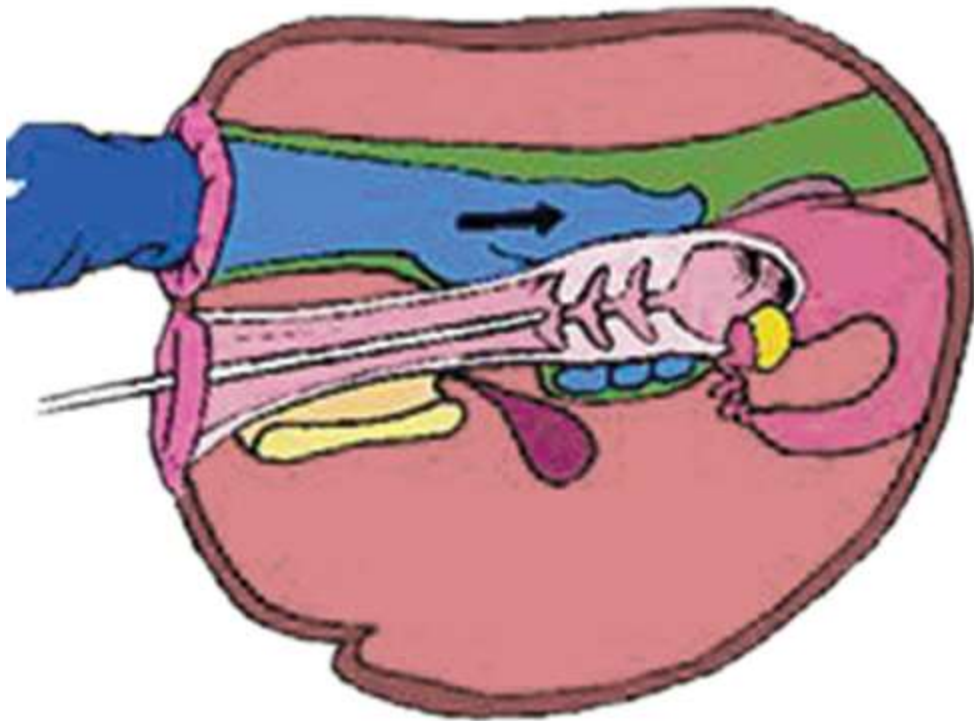


Finding the cervix

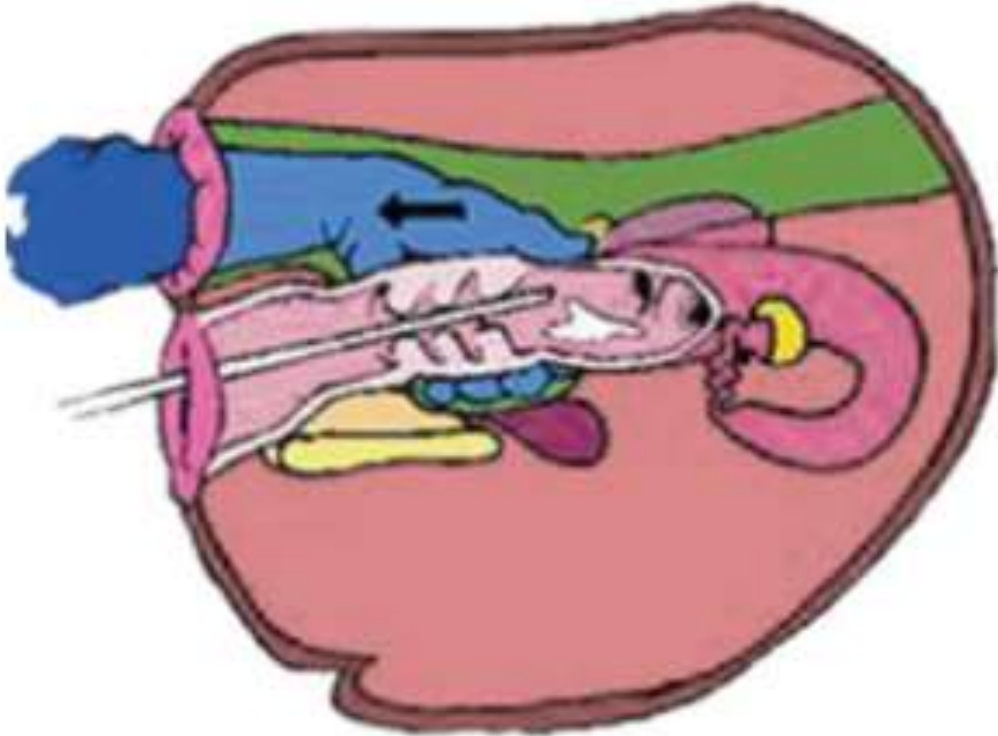


Inserting the AI gun





Lining up the AI gun



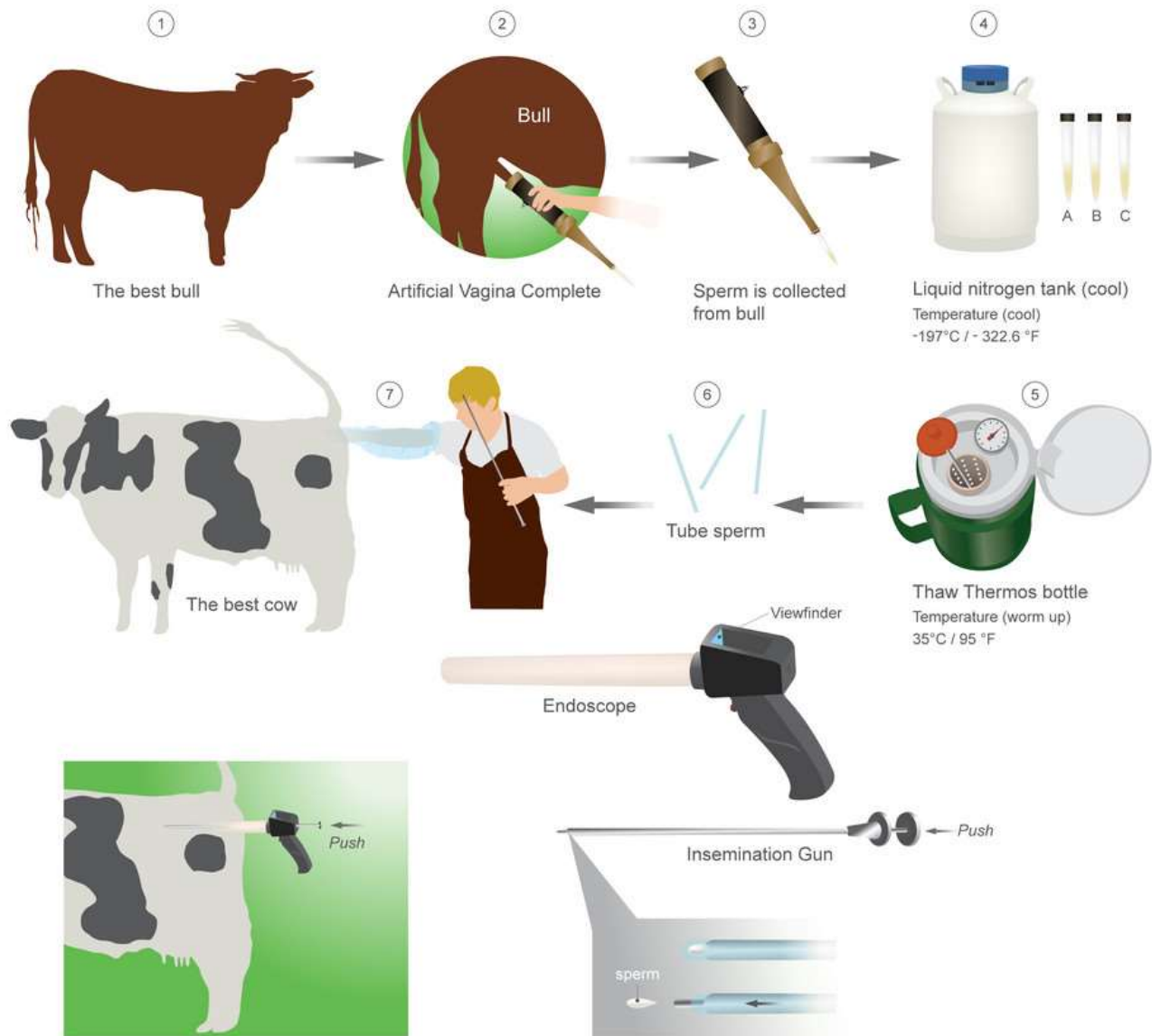
Reaching the cervix

## Timing of Insemination for Maximum Conception

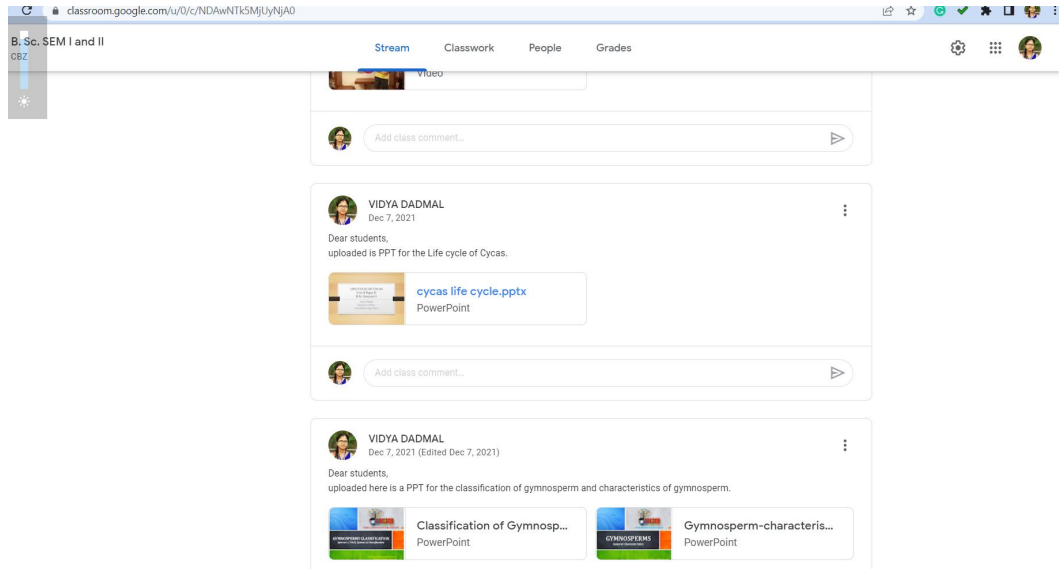
Controlled investigations were conducted by Trim Berger and Davis at Nebraska in 1943. These and other studies show that **maximal conception is obtained when cows are inseminated between mid estrus and the end of standing estrus, with good results up to 6 hours after estrus.**

Success in insemination timing is dependent upon a good heat detection program. In large herds, this means assigning individual responsibility for heat detection and a continued education program for labor. A successful heat detection program and subsequent proper timing of insemination will pay dividends in increasing reproductive efficiency.

# Artificial Insemination of Cow

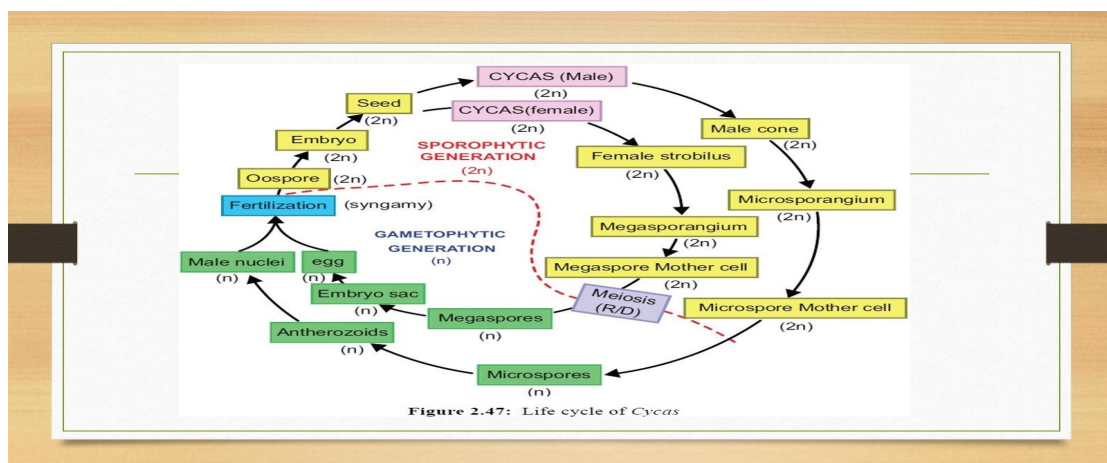
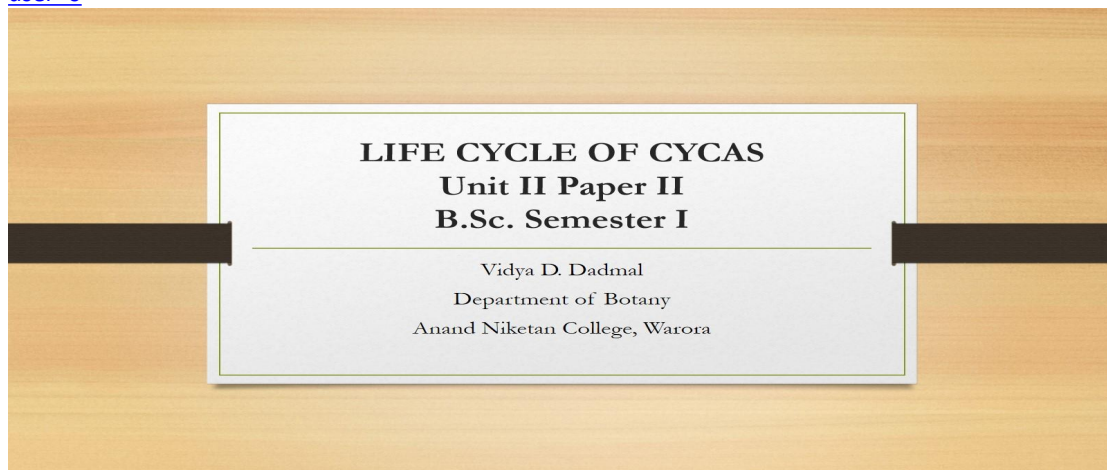


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ICT ENABLED TEACHING AND LEARNING**



Link for Uploaded PPT:

[https://drive.google.com/file/d/100HdoGTXz6BAK3vWkfxqpRIIE78NzTyR/view?usp=drive\\_web&authuser=0](https://drive.google.com/file/d/100HdoGTXz6BAK3vWkfxqpRIIE78NzTyR/view?usp=drive_web&authuser=0)





ANAND NIKETAN COLLEGE, ANANDWAN  
DEPARTMENT OF BOTANY  
ICT ENABLED TEACHING AND LEARNING

## VEGETATIVE REPRODUCTION

- By bulbils
- The bulbils develop from the axil of the scaly leaves.
- Several scaly leaves are arranged spirally and compactly over a dormant stem in a bulbil.
- On detachment from the stem, a bulbil starts germination by producing many roots towards the lower side and a leaf towards the upper side.

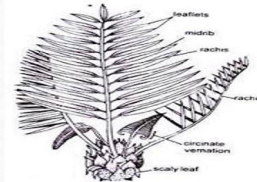


Fig. 8.30. Cycas. A single bulbil.

## Morphology of Cycas plant

- Cycas is a palm-like, evergreen plant.
- The plant body consists of a columnar aerial trunk with a crown of pinnately compound leaves as its top.
- Root in Cycas are of two type: normal tap root system and coralloid roots
- The stem is thick, woody and usually unbranched. It is tuberous when young but columnar, erect and stout at maturity.
- Dimorphic leaves: green, assimilatory or foliage leaf and scaly leaves or cataphyllus.



## SEXUAL REPRODUCTION



Male Cone (Cycas)

- Cycas is the only genus of Cycadaceae which does not produce any female cone. Instead, several megasporophylls arise spirally in acropetal succession around the stem apex of the female plant.



## Development of Microsporangium

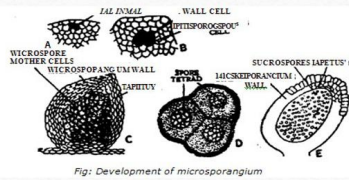


Fig: Development of microsporangium

It is eusporangiate type.

Few hypodermal sporangial initial divide periclinally to form outer primary wall and inner sporogenous cell.

Outer primary wall produce 5-6 cell thick wall of sporangium.

Sporogenous cell further divide and develop into microspore mother cell.

MMC undergo meiosis division produce haploid microspores or pollen grains arranged tetrahedrally.

Tapetum utilized for spore formation,

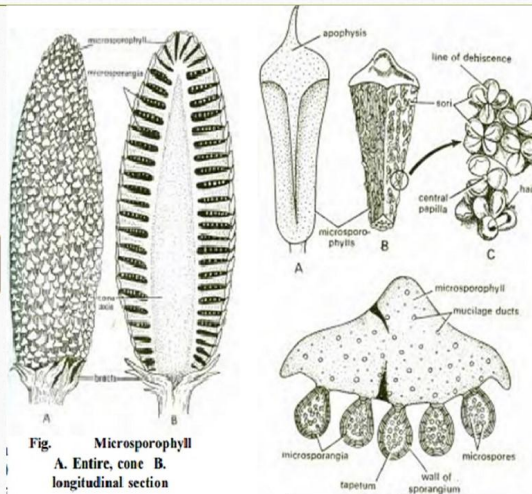


Fig. Microsporophyll  
A. Entire, cone B. longitudinal section

Microsporophyll are flat leaf like, woody and brown color structures with narrow base and expanded upper portion which become pointed called apophysis

On adaxial surface ridge like projection is present  
On abaxial surface microsporangia is present in group.

Each such group is called sorus.

In between these group hair like structure is present.

Oval or sac like microsporangia is surrounded by 5-6 layers(outer epidermis or exothecium, middle inner wall cell, innermost is tapetum )

Many pollen grain present in microsporangium.

Expanded region of microsporophyll mucilaginous canal and vascular bundles are present.

## Female cone



True female cone is absent in Cycas

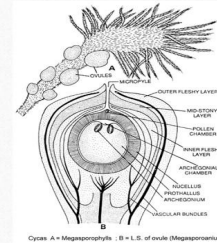
Megasporophyll are loosely arranged in crown

On the apex of the main stem the megasporophylls arises in an acropetal succession.

Megasporophyll in Cycas are produce only once in year

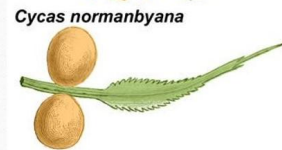
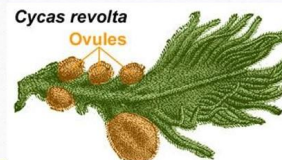
## Structure of ovule

Orthotropous, unitegmic and shortly stalked.  
Single integument is thick and cover the ovule all side except a mouth like opening called micropyle.  
Integument consist 3 layer: outer called sarcotesta, middle called sclerotesta, inner.  
Nucellus grows out into a beak like portion, certain cell of the top of nucellus dissolve and form pollen chamber.  
Nucellus is reduced in the form of a thin papery layer in mature seeds enclose the massive female gametophyte.  
Embryo sac/ megaspore present within nucellus.  
The endosperm form by the repeated division of the megaspore nucleus followed by free cell formation.  
Just below the pollen chamber is present an archegonial chamber.

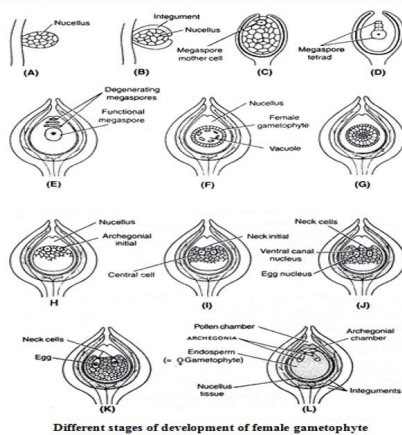


## Megasporophyll

Each megasporophyll is modified foliage leaf. It is flat body consisting an upper dissected or pinnate leafy portion, middle ovule-bearing portion and proximal petiole. They are green when young but at maturity they are fleshy and bright orange or red-colored.



**Cycadales (cycads) - Cycas spp. megasporophylls ("carpels").**  
From: Zimmermann (1930), Die Phylogenie der Pflanzen, Verlag von Gustav Fischer, Jena.  
Drawing: Karsten. Colorization: Leubner.  
© 2007 Gerhard Leubner - The Seed Biology Place - [www.seedbiology.de](http://www.seedbiology.de)



Different stages of development of female gametophyte

- In nucellus regions the nucleus of the cell enlarge
- Its cytoplasmic contents become dense and it also increase in size.
- This cell represents the megaspores mother cell, which undergo meiosis to form four haploid megaspores arranged in a linear tetrad.
- Out of these four megaspores, the upper three present towards the micropylar end degenerate, leaving only the lowermost functional megaspore or embryo sac cell.
- This is the first cell of gametophyte.
- The archegonia develop from the gametophytic cells lining the archegonial chamber towards the micropylar end.
- Any cell enlarge in size and functions as archegonial initial which later on after repetitive division develops into archegonium.





# DEPARTMENT OF ELECTRONICS

Anand Niketan College, Anandwan, Warora - 442 914

HOD: Dr. G. K. Singh, Cell: 9075322625, Email: ugclasses@gmail.com



## ICT FACILITIES FOR TEACHING-LEARNING



- Department is well equipped with ICT facilities for effective teaching-learning
- In addition to View Sonic Projector, it has Cybernetix Eyeris Ix series, Interactive Device Unit installed that makes whiteboard interactive
- It has high speed fibre cable internet facility
- It has six computers and four of them relate to internet
- Departmental faculty members use Microsoft Teams and Google Meet for online teaching-learning

PowerPoint Slide Show - 2. Kirchhoff's Current and Voltage Laws - Pow...

Ele S-1

17:43

GS VD SS  
G K Singh L... On hold SWARUPAT...

megha (Guest) ...

Slide 1 of 14

Type here to search 19°C Haze 07:14 PM 29-01-2022

**A Circuit / Network:b**

- A closed path consisting of two or more components interconnected by conducting paths is called a circuit.
- The components may be active or inactive or both.
- Path:** A single line of connecting elements or sources.
- Node:** • A node is indicated by a dot.
- A node is a junction, connection or terminal within a circuit where two or more circuit elements are connected or joined together giving a connection point between two or more branches.

Online teaching-learning with Microsoft Teams





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The screenshot shows a Microsoft Teams meeting interface. On the left, a PowerPoint slide titled "Types of Programming language" is displayed. The slide contains a diagram of a pyramid with four levels: "FORTRAN C PASCAL" at the top, "High-Level Language" below it, "Assembly Language" below that, and "Machine Language" at the bottom. Below the pyramid, it says "CPU (Hardware)". To the right of the diagram, there are four bullet points: "CPU (Central Processing Unit) of computer functions with machine language.", "Each different type of CPU has its own unique machine language.", "Machine language consists of binary numbers only.", and "Remembering and using instructions written in machine language is difficult." The right side of the screenshot shows a grid of video thumbnails for participants: Mohan Virutkar, Pratiksha Kadurkar, Kalyani Bhojar, swarupata sarpate, Megha S. Rangari, and You. The bottom of the screenshot shows the Windows taskbar with the time 09:05 PM on 29-01-2022.

Online teaching-learning with Microsoft Teams

## LINK FOR LECTURE VIDEOS AND PDF FILES

1. Digital Book link for B. Sc. Electronics Sem-V P-II:  
<https://ancollege.edu.in/wp-content/uploads/2022/07/C-Learning-E-Content-Module-for-B.-Sc.-Electronics-S-V.pdf>
2. Digital Practical Book link for B. Sc. Electronics Sem-V:  
<https://ancollege.edu.in/wp-content/uploads/2022/07/C-Practical-Learning-E-Content-Module-for-B.-Sc.-Electronics-S-V.pdf>
3. Digital Book link for B. Sc. Electronics Sem-VI P-II:  
<https://ancollege.edu.in/wp-content/uploads/2022/07/C-Learning-E-Content-Module-for-B.-Sc.-Electronics-S-VI.pdf>
4. S-III P-I U-I PDF Files
5. S-III P-I U-II PDF Files  
<https://drive.google.com/drive/folders/1eTj-JIGYNAbXPwSr9hjbRmdEG3h1v7Ox?usp=sharing>
6. S-I P-I U-I PDF Files  
<https://ancollege.edu.in/wp-content/uploads/2022/07/B.-Sc.-Ele.-S-I-P-I-U-I.pdf>
7. S-II P-II U-I PDF File  
<https://ancollege.edu.in/wp-content/uploads/2022/07/B.-Sc.-Ele.-S-II-P-II-U-I.pdf>



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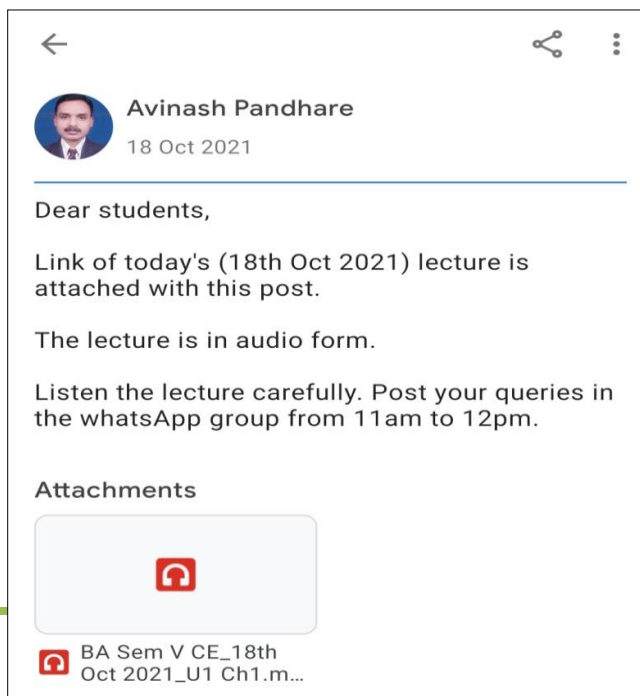
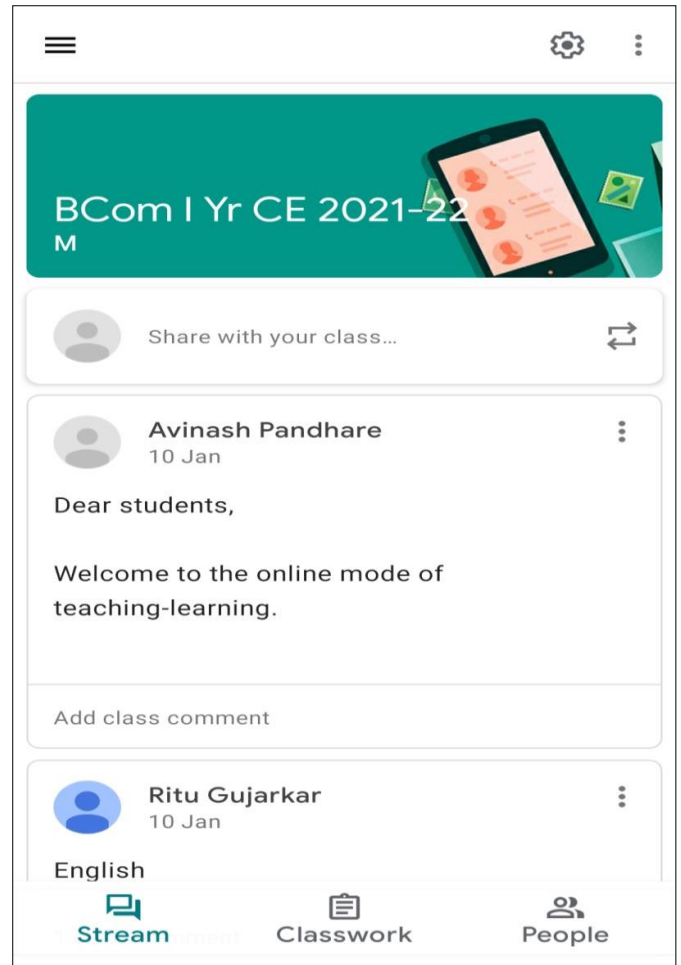
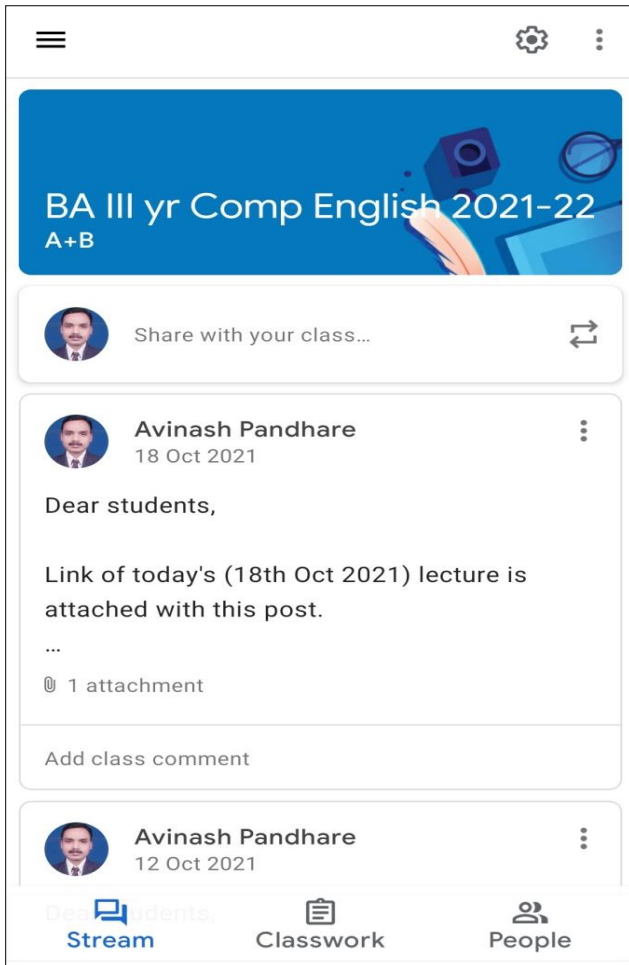


8. S-II P-II U-II PDF File  
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9. S-III P-I U-I PDF File  
<https://ancollege.edu.in/wp-content/uploads/2022/07/B.-Sc.-Ele.-S-III-P-I-U-I.pdf>
10. S-III P-I U-II PDF File  
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11. S-IV P-II U-I PDF File  
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13. S-IV P-II U-IV PDF File  
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14. C&C++ Certificate Course PDF File  
<https://ancollege.edu.in/wp-content/uploads/2022/06/C-C-Certificate-Course.pdf>

# Use of ICT in Teaching – 2021-22

-Dr. Avinash L. Pandhare

## A. Google Classroom



Dr. Avinash L. Pandhare

## B. Online Lecture and Unit Test

**B A Sem V**  
**Comp English**  
**(Syllabus & Que Paper Pattern)**

By  
**Avinash L. Pandhare**  
Anand Niketan College,  
Anandwan-Warora

The slide features a white background with a blue wavy header. A play button icon is centered on the slide. In the bottom-left corner, there is a small video inset showing a man in a white shirt speaking.

docs.google.com/forms/

BA Sem VI (Com Eng) - Unit Test 3

Questions Responses 36 Settings

Two or more main clauses are joined by words (or pairs of words). These are called \_\_\_\_\_.

- subordinating conjunctions
- coordinating conjunctions
- C. pairing words
- joining words

Capital letters/alphabets are also called \_\_\_\_\_.

- bold letters
- big letters
- upper-case letters

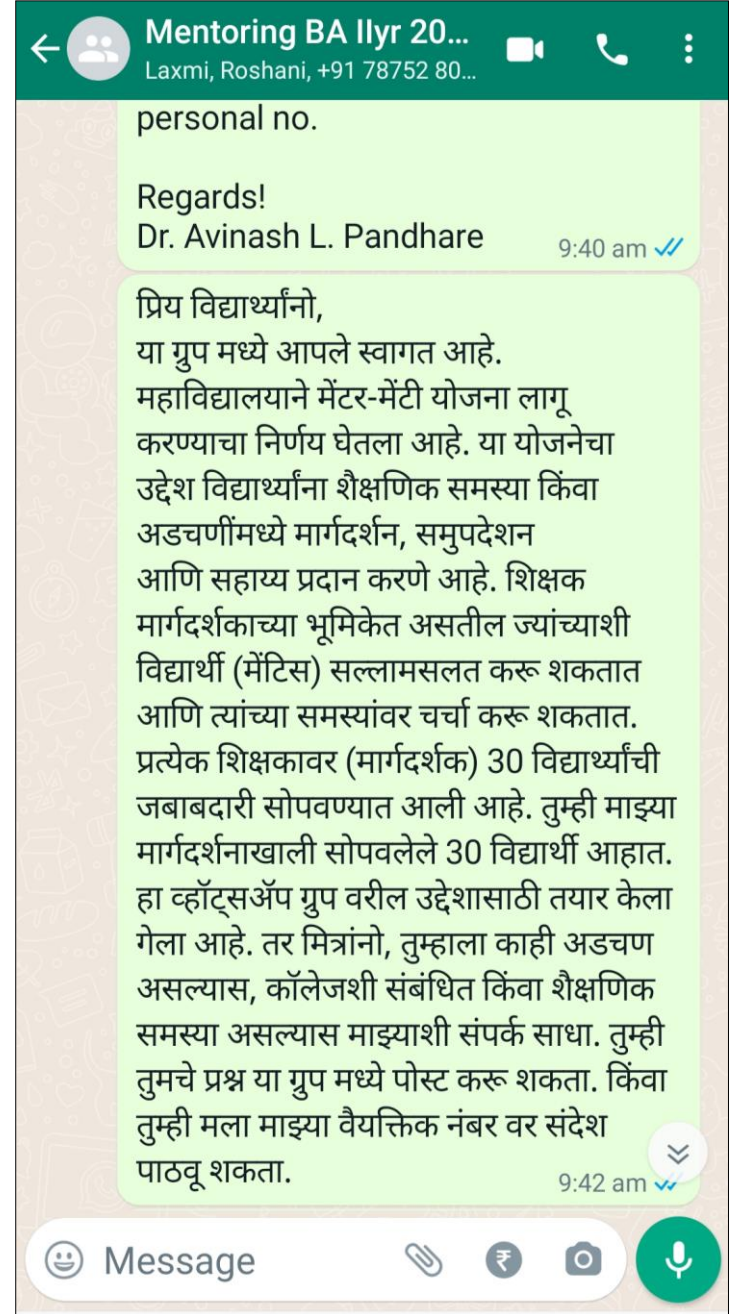
BA Sem VI (Com Eng) - Unit Test 3

Questions Responses 36 Setting: Total points: 40

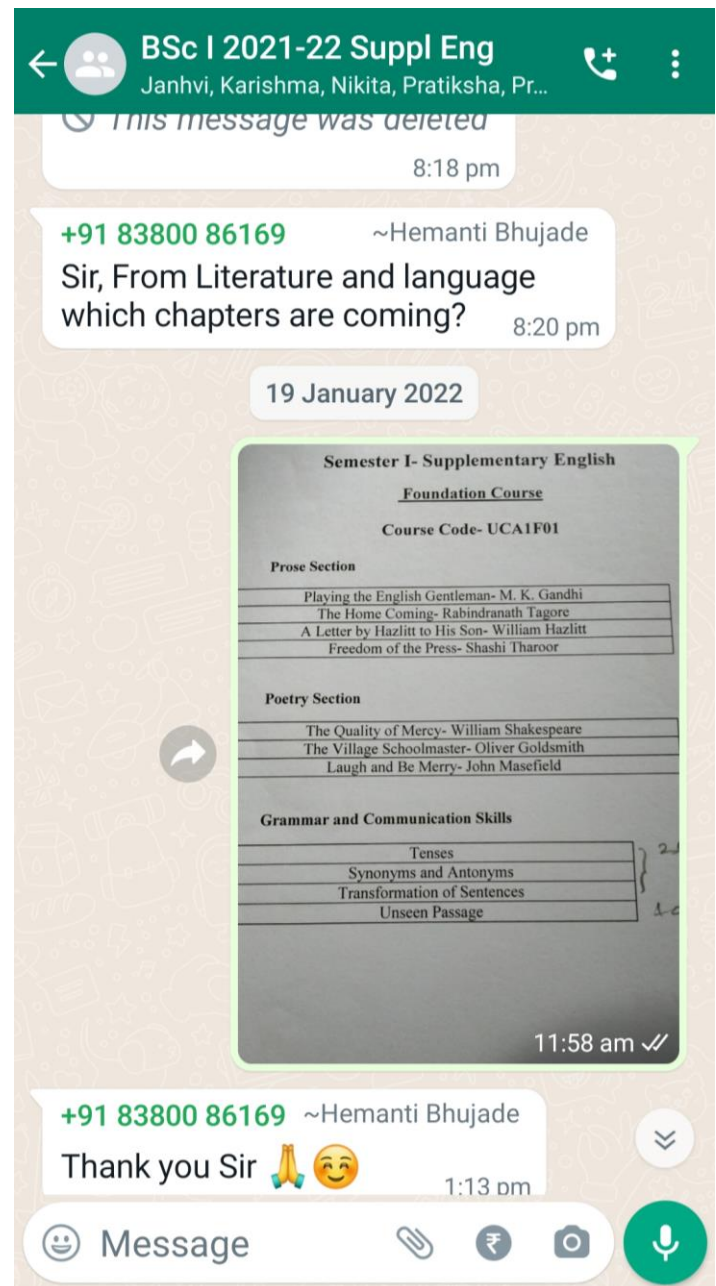
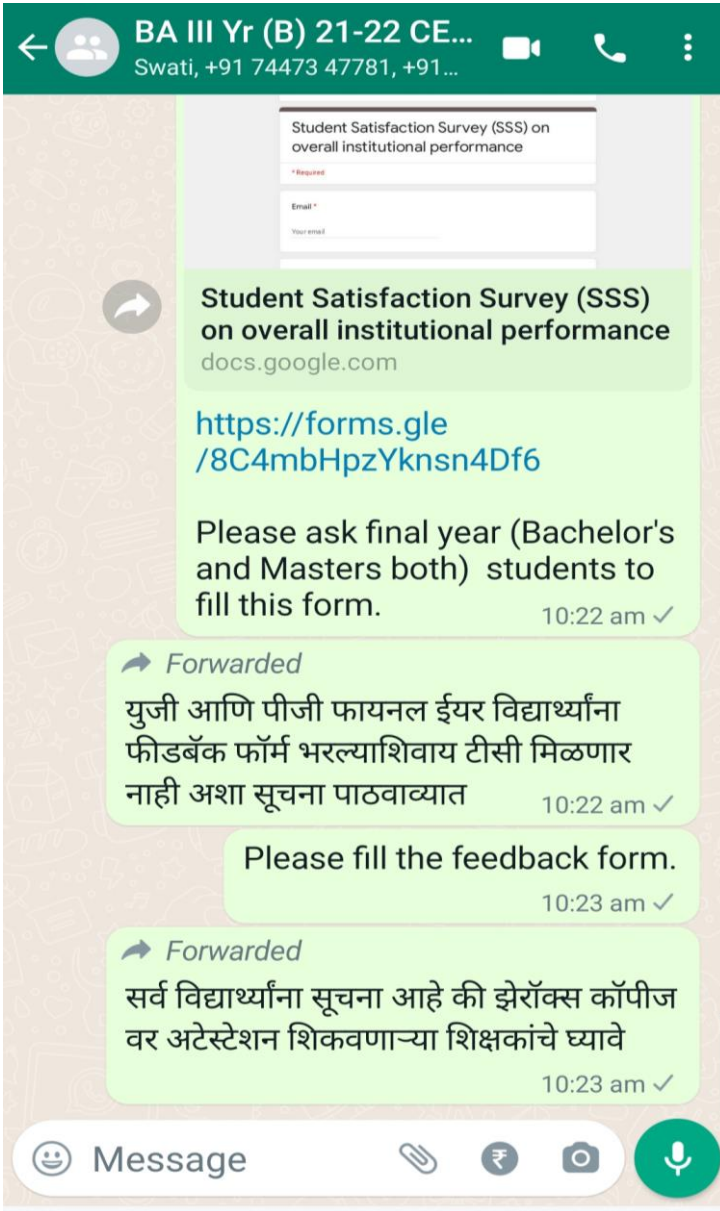
Scores [Release scores](#)

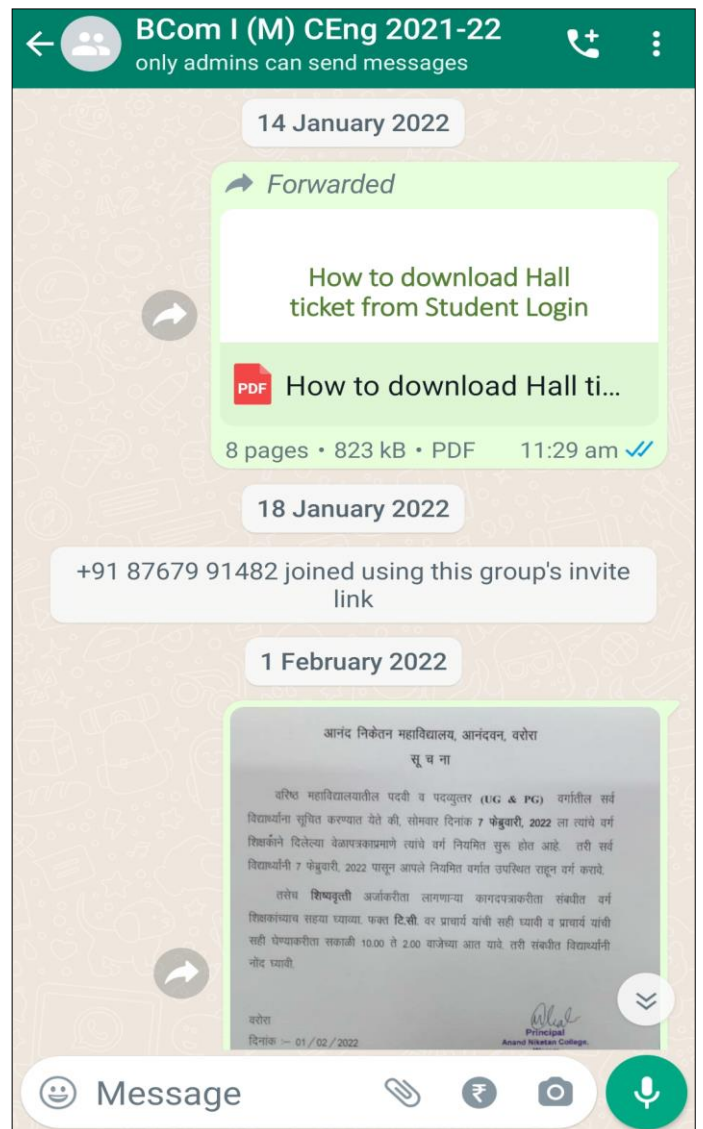
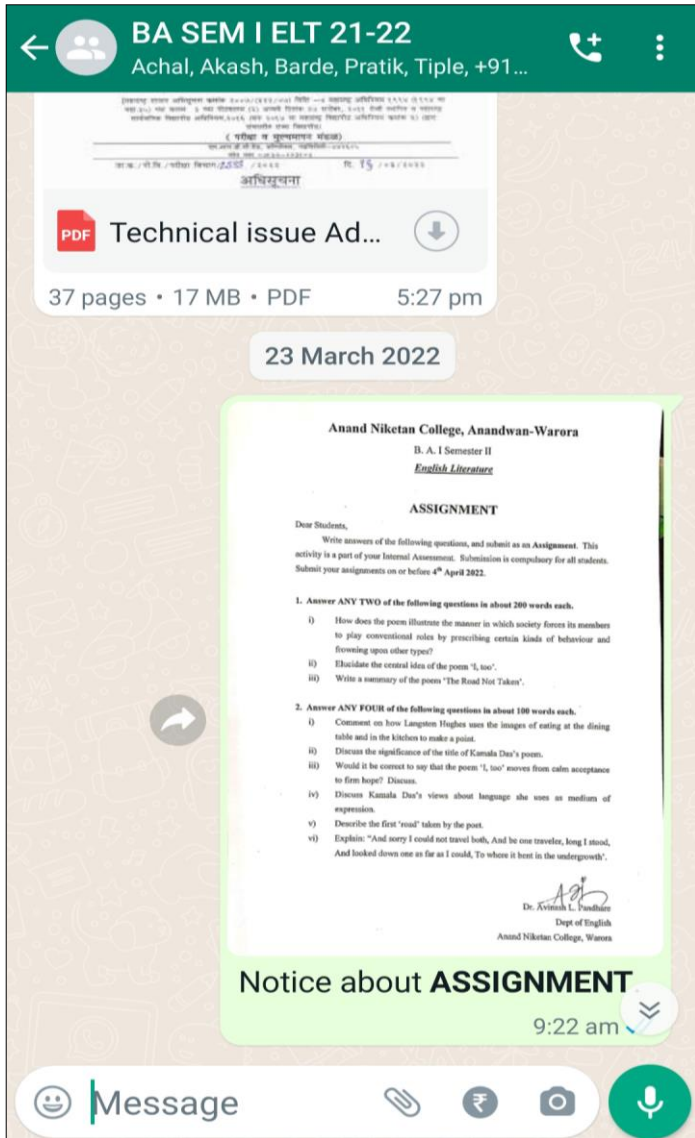
anmanmankar@gmail.com	40
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sunitamagre939@gmail.com	8
madhurutumsare792@gmail.com (2)	30
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madhurutumsare792@gmail.com (3)	30
madhurutumsare792@gmail.com (4)	36
madhurutumsare792@gmail.com (5)	34
madhurutumsare792@gmail.com (6)	38
madhurutumsare792@gmail.com (7)	34

## C. Use of Whatsapp









- औद्योगिक क्रांतीची कारणे स्पष्ट करा ? औद्योगिक क्रांती प्रथमतः इंग्लंड कां झाली ? औद्योगिक क्रांतीचे परिणाम सांगा.

औद्योगिक क्रांती ही आधुनिक काळात जागतीक इतिहासाला कलाटणी देणारी महत्त्वाची घटना होय, अठराव्या शतकाच्या शेवटी व १९ व्या शतकाच्या सुरुवातीला उत्पादन पद्धतीमध्ये आमुलाग्र परिवर्तन घडून आले. या घटनेला औद्योगिक क्रांती म्हणतात. औद्योगिक क्रांतीचे परिणाम केवळ औद्योगिक क्षेत्रातच नव्हे तर राजकिय, सामाजिक, आर्थिक इ. जिवनाच्या प्रत्येक क्षेत्रावर झाले. या क्रांतीचे दुरगामी परिणाम मानवी जिवनावर पडले. तसेच या क्रांतीमुळेच एकीकडे प्रचंड सुबत्ता माणसाला प्राप्त झाली तर याच क्रांतीमुळे अपार दुःखही माणसाला भोगावे लागले. औद्योगिक व उत्पादनाच्या क्षेत्रातील अमुलाग्र परिवर्तनाला औद्योगिक क्रांती म्हटले जाते. ही क्रांती प्रथमतः इंग्लंडमध्ये झाली व १८ व्या शतकाच्या उत्तरार्धात ते १९ व्या शतकाचा पुर्वाध या क्रांतीचा काळ मानल्या जातो. हस्तव्यवसायाची जागा यंत्रव्यवसायाने घेण्याची प्रक्रीया म्हणजेच औद्योगिक क्रांती होय असेही या क्रांतीचे वर्णन केले जाते. अशी ही क्रांती काही एकाएकी घडून आली नाही अनेक घटक या क्रांतीस कारणीभूत ठरले.

औद्योगिक क्रांतीचे प्रमुख कारणे पुढीलप्रमाणे सांगता येतील.

- वैज्ञानिक प्रगती व तंत्रज्ञानविषयक शोध :-

औद्योगिक क्रांतीचे प्रमुख कारण विज्ञानाची प्रगती हे आहे. अठराव्या शतकाच्या उत्तरार्धात तंत्रज्ञानविषयक अनेक नवे शोध लागले. या शोधामुळेच औद्योगिक क्रांती घडून आली हे खरे असले तरी तंत्रज्ञानविषयक शोधांना विज्ञानाची प्रगतीच कारण ठरली होती. हे लक्षात घेणे आवश्यक आहे. युरोपातील पुनरुज्जीवनाच्या चळवळीने वैज्ञानिक प्रगतीला खऱ्या अर्थाने चालना मिळाली. पुनरुज्जीवनाच्या चळवळीमुळे युरोपात व्यक्तीस्वातंत्र्याचे व विचारस्वातंत्र्याचे नवे वारे वाहू लागले. लोकांना आपले विचार मोकळेपणाने व्यक्त करण्याची संधी मिळाली. त्यामुळे ज्ञान व विद्या यांचा प्रसार होण्यास अनुकूल वातावरण तयार झाले. विचारांच्या अभिव्यक्तीवरील पूर्वीची सर्व बंधने दुर झाली. त्यातूनच विज्ञानाच्या क्षेत्रात प्रयोगशिलतेला वाव मिळून विज्ञानाची झपाट्याने प्रगती होऊ लागली. अनेक वैज्ञानिकांनी नवे सिद्धांत पुढे मांडले. विज्ञानाच्या प्रगतीमुळे पुढे तंत्रज्ञानाचा विकास घडून आला. वैज्ञानिक प्रगतीखेरीज तंत्रज्ञानविषयक शोध लागणे शक्य नव्हते. कारण हे शोध विज्ञानातील सिद्धांतावर आधारित होते. उदा. पदार्थविज्ञानाचा विकास होऊन उष्णता, वायू इत्यादींची माहिती मानवाला उपलब्ध झाल्यावरच बाष्पशक्तीवर चालणाऱ्या इंजिनाचा शोध लागला. तेव्हा औद्योगिक क्रांतीचे मुळ विज्ञानाच्या प्रगतीत आहे. विज्ञानाच्या प्रगतीमुळे तंत्रज्ञानविषयक शोध लागले. या शोधांमुळे उत्पादन पद्धतीत बदल होऊन उत्पादन मोठ्या प्रमाणावर केले जाऊ लागले. त्यातूनच औद्योगिक क्रांतीचा पाया रचल्या गेला.

- व्यापारातील वाढ :-

सोळाव्या शतकापासून युरोपीय देशांच्या व्यापारास सातत्याने वाढ होत गेली. मध्ययुगीन काळाच्या अखेरीस युरोपातील साहसी प्रवाशांनी नवे जलमार्ग शोधून काढले. त्यामुळे युरोपीय राष्ट्रांचे बाह्य जगाशी व्यापारी संबंध प्रस्थापीत झाले. पुढील काळात युरोपात व्यापारवादी विचारसरणीचा प्रभाव वाढला. परदेशांशी मोठ्या प्रमाणावर व्यापार वाढविणे, आपल्या राष्ट्राला अनुकूल व्यापारशेष मिळविणे आणि त्यायोगे राष्ट्राला आर्थिकदृष्ट्या समृद्ध बनविणे हे व्यापारवादाचे मुलभूत तत्व होते. या व्यापारवादी विचारसरणीमुळे इंग्लंडसारख्या युरोपीय राष्ट्रांकडे संपत्तीचा ओघ मोठ्या प्रमाणावर वाहू लागला. त्याचप्रमाणे व्यापारात वाढ झाल्याने उत्पादित वस्तूंच्या मागणीत वाढ झाली. वस्तूंच्या वाढत्या मागणीमुळे उत्पादनात वाढ करण्याची निकड जाणवू लागली. त्यातूनच उद्योगधंद्याच्या वाढीला प्रोत्साहन मिळाले.



- **भांडवलाची निर्माती :-**

उत्पादनासाठी यंत्राचा उपयोग केला जाऊ लागल्यामुळे उत्पादनात पूर्वीपेक्षा कितीतरी पटींनी वाढ झाली. अर्थात मोठ्या प्रमाणावर उत्पादन करण्यासाठी भांडवलांची गरज पूर्ण होणे आवश्यक होते. कारण मोठ्या प्रमाणावर कच्च्या मालाची खरेदी, यांत्रिकीकरण, मजुरी इत्यादी बाबींच्या पुर्ततेसाठी भांडवलांची गरज भासते. इंग्लंडमध्ये सोळाव्या शतकानंतर झालेल्या व्यापारी क्रांतीमुळे इंग्लंडकडे परदेशांतून संपत्तीचा ओघ वाहू लागला होता. इंग्लंडने आपली आयात उद्योगधंद्यासाठी लागणाऱ्या कच्च्या मालापुरतीच मर्यादीत राखली होती आणि निर्यात व्यापारात प्रचंड वाढ घडवून आणली होती. परिणामी उपयोग केला जाऊ लागला तेव्हा उद्योगधंद्यातील भांडवलाची गरज भागविण्यासाठी हा वर्ग पुढे आला.

- **बाजारपेठांची उपलब्धता :-**

बाजारपेठांची उपलब्धता हे औद्योगिक क्रांतीचे आणखी एक महत्वाचे कारण होते. औद्योगिक क्रांतीच्या काळात वस्तूंचे उत्पादन मोठ्या प्रमाणावर होऊ लागले. उत्पादनासाठी यंत्राचा वापर करण्यात येऊ लागल्याने उत्पादनात मोठ्या प्रमाणावर वाढ घडून आली. या उत्पादित वस्तूंना बाजारात मागणी असणे ही उद्योगधंद्यांच्या वाढीच्या दृष्टीने महत्त्वाची गरज होती. उत्पादित मालाची विक्री झाली तरच उत्पादनाची प्रक्रीया चालू ठेवणे शक्य होणार होते. म्हणजेच उद्योगधंद्यांची वाढ उत्पादित वस्तूंच्या विक्रीसाठी हुकमी बाजारपेठ उपलब्ध होण्यावर अवलंबून होती. अठराव्या शतकाच्या उत्तरार्धात इंग्लंडने जगाच्या विविध भागांत आपल्या वसाहती स्थापन केल्या होत्या. इंग्लंडच्या या वसाहतवादी धोरणामुळे वसाहती देशांतील हुकमी बाजारपेठात इंग्लंडला आपोआपच उपलब्ध होऊ शकल्या. युरोपात औद्योगिककरणाचा वेग वाढल्यावर युरोपातील निरनिराळ्या देशांत वसाहतींसाठी जे

- **कच्च्या मालाची उपलब्धता :-**

औद्योगिक क्रांती घडून येण्यासाठी कच्च्या मालाच्या उपलब्धतेची गरज होती. उत्पादन पद्धतीमधील बदलांमुळे उत्पादनात मोठ्या प्रमाणावर वाढ झाली हे खरे असले, तरी वाढत्या उत्पादनांसाठी उद्योगधंद्यास लागणाऱ्या कच्च्या मालाचा पुरवठा पुरेशा प्रमाणात होणे हे देखील गरजेचे होते. या काळात इंग्लंडसारख्या देशात कृषीक्रांती घडून येत होती. या क्रांतीमुळे शेतमालाच्या उत्पादनात मोठ्या प्रमाणावर वाढ होत होती. युरोपीय राष्ट्रांना त्यांच्या वसाहतींमधून कच्च्या मालाचा पुरवठा होऊ लागला होता. युरोपीय राष्ट्रांनी आपल्या व्यापारविषयक धोरणात कच्च्या मालाची आयात व पक्क्या मालाची निर्यात या तत्वाला प्राधान्य दिले होते. आयात-निर्यात व्यापारासंबंधीच्या युरोपीय राष्ट्रांच्या वरील धोरणांमुळे त्यांना उद्योगधंद्यासाठी कच्चा माल पुरेशा प्रमाणावर उपलब्ध होऊ शकला. याशिवाय उद्योगधंद्यासाठी आवश्यक असलेल्या लोखंड, कोळसा इत्यादी कच्च्या मालाची कमतरताही इंग्लंडसारख्या देशांत जाणवली नाही. कारण या देशात लोखंड, कोळसा या खनिजांचे साठे विपूल प्रमाणावर उपलब्ध होते. वरील प्रकारच्या कच्च्या मालाच्या उपलब्धतेमुळे औद्योगिक क्रांतीला अनुकूलता व गती प्राप्त झाली.

- **औद्योगिक क्रांती प्रथम इंग्लंडमध्येच का झाली ?**

औद्योगिक क्रांती प्रथम इंग्लंडमध्ये झाली. अर्थात, हा काही केवळ योगायोग नव्हता. इंग्लंडमधील विशिष्ट परिस्थिती औद्योगिक क्रांती प्रथम त्या देशात घडून येण्यास कारणीभूत झाली होती.

औद्योगिक क्रांतीच्या ज्या कारणांचा आपण वरील विवेचनात आढावा घेतला ती सर्व कारणे इंग्लंडमध्ये आढळून येत होती. इंग्लंडने सोळाव्या शतकापासूनच परिक्रिय व्यापारात आघाडी घेऊन जगाच्या निरनिराळ्या प्रदेशांत आपल्या हुकमी बाजारपेठा निर्माण केल्या होत्या. त्यामुळे इंग्लंडच्या उत्पादनाला बरीच

मागणी होती. इंग्लंडने परकिय व्यापारातून मोठ्या प्रमाणावर भांडवलसंचयही केला होता. त्यामुळे आधुनिक उद्योगधंद्यांच्या विकासाला तेथे अनुकूल परिस्थिती निर्माण झाली होती.

अर्थात, अशा प्रकारची अनुकूलता इंग्लंडप्रमाणे व युरोपातील फ्रान्स, हॉलंड यांसारख्या अन्य देशांतही होती. फ्रान्स व इंग्लंड यांची या संदर्भात तुलना करता असे दिसते की, इंग्लंडप्रमाणे फ्रान्सनेही आपला परकिय व्यापार मोठ्या प्रमाणावर वाढविला होता. जगात या दोन्ही देशांच्या इतरत्र वसाहती स्थापन झाल्या होत्या. फ्रान्समध्येही आपला परकिय व्यापार मोठ्या प्रमाणावर म्हणजे औद्योगिक क्रांतीस अनुकूल ठरणारे काही घटक युरोपातील इतर काही देशांतही अस्तित्वात होते.

इतके असूनही औद्योगिक क्रांती प्रथम इंग्लंडमध्येच झाली. याचे कारण या क्रांतीस पूरक ठरणारे काही घटक फक्त इंग्लंडमध्येच अस्तित्वात होते. ते युरोपच्या इतर देशांत आढळून येत नव्हते. या संदर्भात इंग्लंडने तंत्रज्ञानाच्या क्षेत्रात केलेल्या प्रगतीचा विशेषत्वाने उल्लेख करावा लागेल. इंग्लंडच्या संशोधकांनी निरनिराळे यांत्रिक शोध लावले आणि त्यांच्या उपयोग उत्पादनासाठी करून घेतला. फ्रान्स किंवा अन्य कोणत्याही राष्ट्राने तंत्रज्ञानाच्या क्षेत्रात अशी प्रगती केली नव्हती.

इंग्लंडमधील राजकिय स्थर्य, राजसत्तेने औद्योगिक विकासाला दिलेले प्रोत्साहन, इंग्लंडमधील शांतता व सुव्यवस्थेची परिस्थिती हे घटकही औद्योगिक क्रांतीच्या दृष्टीने महत्त्वपूर्ण ठरले होते. याशिवाय इंग्लंडमधील नैसर्गिक साधनसंपत्तीची उपलब्धता, बँकीक व्यवसायाचा झालेला विकास, वाहतुकीच्या सोयी इत्यादी घटकही औद्योगिक क्रांतीस पूरक ठरले होते.

#### • वस्त्रोद्योग, वाहतुक व खाण व्यवसायांतील बदल :-

औद्योगिक क्रांतीची सुरुवात झाल्यावर उद्योगधंद्यांच्या निरनिराळ्या क्षेत्रांत महत्त्वपूर्ण बदल घडून येऊ लागले. उत्पादनासाठी यंत्राचा वापर करण्याच्या प्रक्रियेत जसजसे यांत्रिक शोध लागत गेले. तसतसा त्यांचा उद्योगधंद्यात अवलंब केला जाऊ लागला. म्हणजे उद्योगधंद्यातील बदल क्रमाक्रमानेच होत गेले. औद्योगिक क्रांतीच्या या काळात वस्त्रोद्योग, वाहतुक व खाण व्यवसायात तीन क्षेत्रांत झालेल्या बदलांची माहिती आपण आता पाहू.

#### 9) वस्त्र-उद्योग :-

उत्पादनासाठी यंत्राचा वापर करण्याची सुरुवात प्रथम वस्त्र उद्योगात झाली. पुर्वी वस्त्र बनविण्यासाठी हातमागाचा उपयोग केला जात होता. औद्योगिक क्रांतीच्या काळात हातमागात सुधारणा घडवून आणणारे निरनिराळे शोध लावण्यात आले. त्यामुळे हातमागाचे यंत्रमागात रूपांतर होऊन उत्पादनाचे प्रमाण वाढले. यातील महत्वाचे शोध व त्यांचे जनक यासंबंधीचा तपशिल पुढीलप्रमाणे सांगता येईल.

जॉन के याने धावत्या धोळ्याचा शोध लावला. त्यामुळे एकच विणकर दोघा जणांचे काम करू लागला.

हारग्रीव्हज याने 'स्पिनींग जेनी' नावाचे सुत कातण्याचे यंत्र शोधून काढले. या यंत्रावर एक माणूस आठ जणांचे काम करू लागला.

रिचर्ड आर्कराईट याने जलशक्तीवर चालणारे 'वाटर फ्रेम' हे यंत्र शोधले. या यंत्रापासून मजबूत धाग्याचे सूत निघू लागले.

सॅमुअल क्रॉम्टन याने शोधलेल्या 'स्पिनींग म्यूल' या यंत्रामुळे मजबूत पण चांगल्या प्रतीचा धागा काढता येऊ लागला.

पुढे कार्टराईट या संशोधकाने यंत्रमागाचा शोध लावला.

व्हिटने याने कापसापासून सरकी वेगळी करण्याच्या यंत्राचा शोध लावला.

## २) वाहतुक :-

वाहतुक क्षेत्रातील शोधांमुळे रेल्वे इंजिनांचा शोध अतिशय क्रांतीकारक ठरला. जार्ज स्टिफन्सन याने इ.स. १८१४ मध्ये रेल्वे मार्गावर धावणाऱ्या वाफेच्या इंजिनाचा शोध लावला. या शोधामुळे रेल्वे मार्गाने वाहतुक करता येऊ लागली.

औद्योगिक क्रांतीमुळे रस्ते वाहतुकीत बरीच वाढ झाली. त्यामुळे जुन्या काळातील कच्चे रस्ते वाहतुकीसाठी गैरसोयीचे ठरू लागले. जॉन मॅकअडम याने खडीचा उपयोग रस्ते बांधणीसाठी करण्याची पद्धती शोधून काढली. त्यामुळे पक्के रस्ते तयार करता येऊ लागले.

जलवाहतुक क्षेत्रात रॉबर्ट फ्ल्टन या संशोधकाने अशीच महत्वाची कामगिरी बजावली. त्याने बाष्पशक्तीवर चालणाऱ्या पहिल्या जहाजाचा शोध लावला. याच्या पुढील टप्पा आगबोटीचा शोध हा होता.

या काळात जलवाहतुकीसाठी कालव्यांचा उपयोग करून घेण्यावर लक्ष पुरविण्यात आले. इंग्लंडमधील अभियंत्यांनी अंतर्गत जलवाहतुकीसाठी कित्येक मैल लांबीचे कालवे तयार केले.

## ३) खाण व्यवसाय :-

औद्योगिक क्रांतीच्या काळात खाण व्यवसायाला विशेष महत्त्व प्राप्त झाले. कारण, खाणीतून मिळणाऱ्या लोखंड व कोळसा या धातुंना उद्योगधंद्यामध्ये खुपच महत्त्व होते. या काळात निरनिराळ्या उद्योगांत लोखंड व कोळसा यांचा मोठ्या प्रमाणावर वापर केला जाऊ लागला. साहजिकच, हे धातु जमिनीतून वर काढणाऱ्या खाणव्यवसायाचे महत्त्व वाढत गेले.

खाणव्यवसायाच्या दृष्टीने जेम्स वॉट याने इ.स. १७६९ मध्ये लावलेला वाफेवर चालणाऱ्या इंजिनाचा शोध महत्त्वपूर्ण ठरला. या इंजिनामुळे कोळशाच्या खाणीतील पाणी जलद गतीने वर काढता येऊ लागले. त्यामुळे कामगारांना खाणीत अधिक सुलभतेने काम करणे शक्य झाले. खाणी अधिक खोलवर खोदल्या जाऊ लागल्या.

खाण व्यवसायाच्या संदर्भात आणखी एक महत्वाचा शोध म्हणजे हॅन्फ्रे हेव्ही याचा 'सेफ्टी लॅप' चा शोध होय. पूर्वी खाणीत काम करतांना आगीच्या धोक्याला कामगारांना तोंड द्यावे लागत असे. सेफ्टी लॅपच्या शोधामुळे हा धोका खुपच कमी झाला.

## • औद्योगिक क्रांतीचे परिणाम :-

औद्योगिक क्रांती ही आधुनिक जगाच्या इतिहासातील एक महत्त्वपूर्ण घटना मानली जाते. या क्रांतीने समाजजीवनाच्या सर्व क्षेत्रावर दुरगामी परिणाम घडवून आणले. मानवी समाजाच्या इतिहासाला नवे वळण देण्याचे कार्य औद्योगिक क्रांतीने केले. या क्रांतीचे पुढील परिणाम विचारात घेता तिने मानवाच्या जिजनात किती महत्त्वपूर्ण बदल घडवून आणले हे स्पष्ट होते.

## १) गृहोद्योग उत्पादनपद्धतीचा अस्त :-

औद्योगिक क्रांतीपूर्व काळात युरोपमध्ये गृहोद्योग उत्पादन पद्धती प्रचलीत होती. या उत्पादनपद्धतीत कारागिर स्वतः च्या घरीच उत्पादनाचे काम करीत असे. उत्पादनप्रक्रियेत त्याच्या कौशल्याला खुपच वाव मिळत असे. पण औद्योगिक क्रांतीमुळे ही उत्पादनपद्धती कालबाह्य ठरून तिचा अस्त झाला.

## २) जुन्या समाजव्यवस्थेचा अस्त :-

कोणत्याही समाजातील उत्पादनाची पद्धती व सामाजिक व्यवस्था यांचा निकटचा संबंध असतो. कारण उत्पादनाच्या प्रक्रियेत व्यक्तिव्यक्तीमध्ये विशिष्ट उत्पादन संबंध निर्माण होतात. हे उत्पादनसंबंध निर्माण होतात. हे उत्पादनसंबंध समाजाची रचना निश्चित करतात. समाजातील जमिन विषयक संबंधावर आधारलेली सरंजामशाही व्यवस्था पंधराव्या शतकानंतर मोडकळीस आली तरी उत्पादन पद्धतीत तिचे अवशेष शिल्लक राहिले होते. गृहोद्योग पद्धतीच्या अस्ताबरोबरच सरंजामशाही व्यवस्थेचे उरलेसुरले अवशेषही लयास गेले.

## ३) भांडवलशाहीचा उदय :-

औद्योगिक क्रांतीने भांडवलशाहीच्या उदयाला मोठाच हातभार लागला. भांडवलशाहीचा उदयास अनेक घटक कारणीभूत झाले होते. औद्योगिक क्रांती हा त्यातील सर्वात महत्वाचा घटक होय. उद्योग धंद्यात मोठ्याप्रमाणावर भांडवलशाहीची गुंतवणूक करण्याची गरज औद्योगिक क्रांतीने निर्माण केली. या गरजेतुन समाजातील नवश्रीमंत वर्गाने आपल्याकडील भांडवल उद्योगधंद्यात गुंतवून उत्पादनाच्या साधनांवर स्वतःची मालकी प्रस्थापित केली. अशाप्रकारे भांडवलशाही व्यवस्थेचा उदय झाला.

## ४) कारखाना उत्पादनपद्धतीचा विकास :-

वरील विवेचनात स्पष्ट केल्याप्रमाणे जुन्या गृहोद्योग पद्धतीत कारागारांचे घर हेच उत्पादनाचे केंद्र होते. कामगार आपल्या घरीच उत्पादनाचे काम करीत असे. पण औद्योगिक क्रांतीमुळे उत्पादन यंत्राच्या साहाय्याने करण्यात येऊ लागले. मोठमोठ्या गिरणी-कारखान्यातुन अशा यंत्राची उभारणी करण्यात आली. कामगारांना गिरणी-कारखान्यात येऊन उत्पादनाचे काम करावे लागले. उत्पादनाची ही नवी पद्धती कारखाना उत्पादन पद्धती म्हणून ओळखली जाऊ लागली.

## ५) उत्पादनाची वाढ :-

औद्योगिक क्रांतीमुळे यंत्र व्यवसायाला सुरुवात झाली. वस्तुंचे उत्पादन यंत्राच्या साहाय्याने केले जाऊ लागले. साहजीकच, उत्पादनांत प्रचंड प्रमाणात वाढ झाली. पुर्वीच्या काळात एक कामगार जेवढे उत्पादन करीत असे त्याच्या कितीतरी अधिक पटीने उत्पादन तो आता करून लागला.

## ६) उत्पादन प्रक्रीयेत कामगाराल दुय्यम स्थान :-

हस्त व्यवसायाच्या पुर्वीच्या उत्पादन पद्धतीत कामगाराल मध्यवर्ती स्थान प्राप्त झाले होते. उत्पादन प्रक्रीयेत कामगारांचे कसब किंवा कौशल्य जास्त महत्वाचे होते. कोणतीही वस्तु कामगार स्वतःच पूर्ण स्वरूपात बनवित असे. त्यामुळे आपल्या कामातुन त्याला नवनिर्मातीचा आनंद उपभोगता येत असे पण उत्पादन यंत्राच्या साहाय्याने करण्यात येऊ लागल्यावर उत्पादन प्रक्रीयेत यंत्राला मध्यवर्ती स्थान प्राप्त झाले. कामगाराला आपली कसब दाखविण्याची संधीच राहिली नाही. तो केवळ यंत्र चालविणारा मजूर बनला. तसेच वस्तुंच्या निर्मातीमधील त्याचा सहभाग अतिशय मर्यादित झाला. त्यामुळे कामापासून मिळणाऱ्या आनंदाला तो पारखा झाला. त्याच्या कामाला साचेबंद स्वरूप प्राप्त झाले.

७) ग्रामीण जिवनाची वाताहत :-

औद्योगिक क्रांतीने ग्रामीण जिवनाची वाताहत केली. खेड्यातील हस्तव्यवसाय बंद पडू लागले. कारण, हस्तव्यवसायाला यंत्रव्यवसायाच्या स्पर्धेत टिकून राहणे अशक्य झाले. यंत्रव्यवसायात एकच कामगार अनेकांचे काम करीत असल्याने उत्पादन खर्च कमी झाला. यंत्रामुळे मालाच्या दर्जातही सुधारणा झाली. परिणामी, हस्तव्यवसाय बंद पडले खेड्यातील कारागीर बेकार बनले आणि ते कामाच्या शोधात शहरांकडे धाव घेऊ लागले. औद्योगिक क्रांतीमुळे शेतीव्यवसायही भांडवली स्वरूप येऊन गरिब शेतकरी व शेतमजुर या व्यवसायातून बाहेर फेकले गेले. त्यांनाही शहरांकडे धाव घेणे भाग पडले.





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सावरकरांचा क्रांतिकारी दृष्टिकोन \*

सावरकरांचा क्रांतिकारी विचार समजून घेण्याआधी क्रांती चा अर्थ व तत्कालीन परिस्थितीला समजून घेणे गरजेचे आहे. साधारणतः ' क्रांती ' म्हणजे बदल किंवा परिवर्तन. पण हा साधा बदल किंवा परिवर्तन नसते.तर समग्र किंवा आमुलाग्र बदल जेव्हा होतो तेव्हा क्रांती म्हणता येते. प्रस्थापित जुन्या मूल्य ,आदर्श व जीवनपद्धती ऐवजी नवीन मूल्य, आदर्श व जीवनपद्धतीची प्रस्थापना होणे म्हणजे क्रांती म्हणता येते.

तत्कालीन काळात ब्रिटिशांनी भारतावर पारतंत्र्य, गुलामी लादली होती. या पारतंत्र्यातून मुक्त होण्यासाठी भारतात स्वातंत्र्य प्राप्तीचा लढा सुरू होता.टिळकांच्या नंतर या लढ्याचे नेतृत्व म.गांधींकडे होते.सत्य ,अहिंसा या शांततेच्या साधनांचा वापर करत हा लढा पुढे जात होता.मात्र काही तरूणांना स्वातंत्र्य प्राप्तीचे ही साधने पूर्णपणे पटत नव्... [Read more](#)

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HISTORY  
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11/2/2021 12:11:37	18 / 100	Kartik
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11/2/2021 12:21:57	92 / 100	शिवा मधुकर टेकाम
11/2/2021 12:22:18	68 / 100	Prajakta bandu chikte
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11/2/2021 12:30:14	88 / 100	sanjivani Anil Pidurkar
11/2/2021 12:30:18	86 / 100	Sandhya sudhakar soyam
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11/2/2021 12:32:12	66 / 100	Payal Ramrao Hanwate
11/2/2021 12:34:24	86 / 100	Pallavi Raju shende
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11/2/2021 12:47:34	78 / 100	Sakshi Ashok Zile
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11/2/2021 12:53:06	90 / 100	Samiksha Rajesh Bhat
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68 / 100 Rupali keshav thakare  
54 / 100 Karina dhanraj punwatkar  
44 / 100 Kartik kishor nehare  
74 / 100 Anuradha Haridas Jambhule  
46 / 100 Shveta maroti rode  
60 / 100 Kajal Nago Jambhule  
74 / 100 Nivrutti madhukar date  
78 / 100 Tejas Ashok Datey  
82 / 100 Sahil panjabrao mangrudkar  
38 / 100 Vishal Suresh Wasekar  
74 / 100 Krushna moreshwar game  
82 / 100 Shruti pundlik dhawas  
70 / 100 Saurabh Gajanan Gawarkar  
50 / 100 Rina Raju kinnake  
74 / 100 9130822419  
60 / 100 Shweta  
92 / 100 Payal parmashwar Nannaware  
76 / 100 Karishma Tarachand Irpachi  
62 / 100 Lokesh Sanjay Sur  
74 / 100 Vaishnavi vinod rokade  
78 / 100 Vaishnavi shravan chandanbatwe  
42 / 100 Dhiraj Anandrao Nahale  
82 / 100 Pratik Raju Date  
82 / 100 Achal Vilas Chandanbatwe  
96 / 100 Nivrutti  
MAHESHWARI PURUSHOTTAM  
84 / 100 WAKDE