* Formulas:-

1* Unit-1

- Loundness & Intensity are related by
  $\boxed{L = k \log_{10} I}$ —— ① [∵ Weber-Frenchner law]

- Intensity → $\boxed{I = \frac{Q}{At} \ \frac{Watt}{m^2}}$

  → $\boxed{I = 2\pi f^2 a^2 \rho v}$

- Threshold Intensity ⇒ 10^{-12} W/m²

- Intensity level / Relative Intensity

  $\boxed{I_L = k \log_{10} (I/I_0) \text{ bel}}$

  $\boxed{I_L = 10 \log_{10} (I/I_0) \text{ dB}}$

  ∵ $\boxed{1 \text{ dB} = \frac{1}{10} \text{ bel}}$

- Absorption of coefficient $a = \frac{\text{Sound energy absorbed}}{\text{Total sound energy incident on it}}$

- Unit of absorption → Sabine / O.W.U

- Sabine's Formula → $E = \frac{E_m}{10^6}$ at $t = T$

- Reverberation Time (T) α $\frac{\text{Volume of hall } V}{\text{Absorption } A}$

$K = 0.167$ ∴ $\boxed{T = \frac{KV}{A}}$ or $\boxed{T = \frac{0.167V}{\Sigma aS}}$

- Measurement of ~~Ad~~ Absorption coefficient of a.

$$\Rightarrow \boxed{A_1 = \frac{0.167V}{S_1}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]}$$

* Ultrasonic

1. Magnetostriction Oscillator Method :-

$$\Rightarrow \boxed{f = \frac{1}{2\pi\sqrt{L_1C_1}}}$$

$$\Rightarrow \boxed{f = \frac{1}{2l}\sqrt{\frac{E}{\rho}}}$$

- θ is angle of diffraction for n^{th} order,

$$\boxed{d\sin\theta = n\lambda}$$

Grating element $d = \frac{\lambda_u}{2}$

Wavelength of ultrasonic waves $\Rightarrow \boxed{\lambda_u = 2n\lambda/\sin\theta}$

$$\boxed{v = f\lambda_u}$$

- SONAR $\longrightarrow$ Velocity $v = \frac{\text{Distance travelled}}{\text{Time taken}}$

$$v = \frac{AC + CB}{t} \approx \frac{2CO}{t} \quad \left[CO = \text{Depth of Sea} = \frac{vt}{2}\right]$$

* Unit-2 Band theory of solids

- The large no. of energy levels resulting from splitting of an energy level will be closely spaced & from an energy continuum that is called
  $\longrightarrow$ Energy Band.

- Valence Band :-

-> The electrons in outermost orbit of an atom are known as valence ~~b~~ ~~bb~~ electrons. The band of energies occupied by valence electrons is valance band.
-> This band may be $\Rightarrow$ completely or partially filled
-> The highest occup band is ...

- Conduction Band :-

-> The band energies occupied by conduction electrons is known as conduction band.
-> This is the uppermost band, having free electrons.
-> Conduction Band → empty → insulators
  → partially filled → conductors
-> It is above the V.B.

- **Forbidden energy gap:-**

→ The gap between VB & CB on energy level diagram is known as ...

→ Electrons are never found in this gap.

- **Conductors:-**

→ Resistivity of conductors lies in range of $10^{-9}\,\Omega m$ at room temp.

- **Semi-Conductors:-**

→ Resistivity ⇒ $10^{-4}\,\Omega m$ to $10^{3}\,\Omega m$ at room temp.

→ It has almost an empty CB & almost filled VB with narrow energy gap separating two bands $= 1eV$.

→ Forbidden energy gap for Ge ⇒ 0.7 eV

Si ⇒ ~~0.3~~ eV
1.1

- **Insulators:-**

→ Resistivity ⇒ $10^{3}\,\Omega m$ to $10^{7}\,\Omega m$ at room temp.

→ F.G is very large & approximately equal to 5eV.

- **Fermi Distribution Function:-**

→ Gives the probability of occupancy of energy levels.

$$f(E) = \frac{1}{1 + e^{\frac{E-E_F}{K_B T}}} \quad (1)$$

For filled energy level, $F(E) = 1$ & unfilled level $f(E) = 0$

- Special cases:-

(1) $T = 0K$, $E < E_F$

$$f(E) = \frac{1}{1+e^{-\infty}} = \frac{1}{1+0} = \boxed{1} \quad (E - E_F \text{ is } -ve)$$

⇓

means all energy level below E_F are occupied by electrons.

(2) $T = 0K$, $E > E_F$

$$f(E) = \frac{1}{1+e^{\infty}} = \frac{1}{1+\infty} = \boxed{0} \quad (E - E_F \text{ is } +ve)$$

⇓

means EL above E_F are vacant i.e. there is not chance of electron occupying energy level above E_F.

- **Kronig-Penny Model:-**

→ Each well has width a & depth V_o.
→ Period of potential is $(a+b)$.
→ In regions where $0 < x < a$, PE is to be zero. $(V=0)$
→ " " $-b < x < 0$, it is $V = V_o$.

- **Bloach Theorem:-**

Region I $\quad \frac{\partial^2 \phi_1(x)}{\partial x^2} + \alpha^2 \phi_1(x) = 0 \qquad \alpha^2 = \frac{2mE}{\hbar^2}$ — (2)

Region II $\quad \frac{\partial^2 \phi_{II}(x)}{\partial x^2} - B^2 \phi_{II}(x) = 0 \qquad B^2 = \frac{2m(V_o - E)}{\hbar^2}$ — (3)

$P' = \frac{m V_o b a}{\hbar^2}$ — (4) $\qquad$ Free electrons ⇒ $(E)\ \frac{p^2}{2m} = \frac{\hbar^2 k^2}{2m}$ — (5)

$\alpha = k = \frac{p}{h}$ — (6)

- Width of EB increases ⇒ value of E (α) increases.
- Width of EB decreases ⇒ value of P (which depends on V_o) increases.