



**IITE, Indus University**  
**Engineering Physics (PH0011)**  
**Assignment**  
**Unit II. Superconductivity and Sound**

**Definitions:** Superconductivity, Critical temperature, Critical magnetic effect, Meissner effect, Acoustics, Reverberation time, Musical sound, Noise, Pitch, Loudness, Timbre, Absorption coefficient 'a', Intensity level, Ultrasonics, Magnetostriction effect, Piezoelectric effect, SONAR.

1. What do you mean by the Superconductivity phenomenon? Explain by plotting Electrical resistivity vs temperature for a superconductor and a normal metal.
2. What are the properties of superconductors? Discuss in detail with necessary diagram/formula.
3. Explain with a diagram, the Meissner effect phenomenon showing the effect on superconductors in the presence and absence of magnetic field.
4. Show that the Magnetic Susceptibility of a superconductor is negative.
5. What is Critical temperature  $T_c$ , Critical current density  $J_c$ , Critical magnetic field  $H_c$ ? Discuss the relation between them with necessary diagram.
6. Differentiate between Type-I and Type-II superconductors.
7. Discuss the characteristics of Musical Sound.
8. What is intensity? Explain with formula.
9. What are the factors affecting acoustics of buildings? Explain with their remedies?
10. Explain the construction and working principle of Magnetostriction method for the production of ultrasound using necessary diagram.
11. Explain the construction and working principle of Piezo electric method for the production of ultrasound using necessary diagram.
12. How to find ocean depth using SONAR technique? Explain in detail with necessary diagram.
13. Discuss the various important applications of Ultrasonic waves.

### Numericals:

1. The critical temperature of Nb is 9.15 K. At zero kelvin, the critical field is 0.196 T. Calculate the critical field at 6 K. (Answer:  $H_c = 0.1117$  T)
2. Calculate the critical current through a long thin superconducting wire of radius 0.5 mm. The critical magnetic field is 7.2 kA/m. (Answer:  $I_c = 22.608$  A)
3. A source of sound has a frequency of 426 Hz and an amplitude of  $0.65 \times 10^{-2}$  m. Calculate the flow of energy across  $1 \text{ m}^2$  per second if the velocity of sound in air is  $340 \text{ ms}^{-1}$  and the density of air is  $1.29 \text{ kg m}^{-3}$ . (Answer:  $6.631 \times 10^4 \text{ W/m}^2$ )
4. A hall of volume  $1000 \text{ m}^3$  has a sound absorbing surface of area  $400 \text{ m}^2$ . If the average absorption coefficient of the hall is 0.2, what is the reverberation time of the hall? (Answer:  $T = 2.08$  s)
5. A cinema hall has a volume of  $7500 \text{ m}^3$ . What should be the total absorption in the hall if the reverberation time is 1.5 seconds is to be maintained? (Answer: 835 sabine- $\text{m}^2$ ).