TRINITY COLLEGE FOR WOMEN
NAMAKKAL
Department of Physics

CONDENSED MATTER PHYSICS

19PPH04-ODD Semester

Presented by

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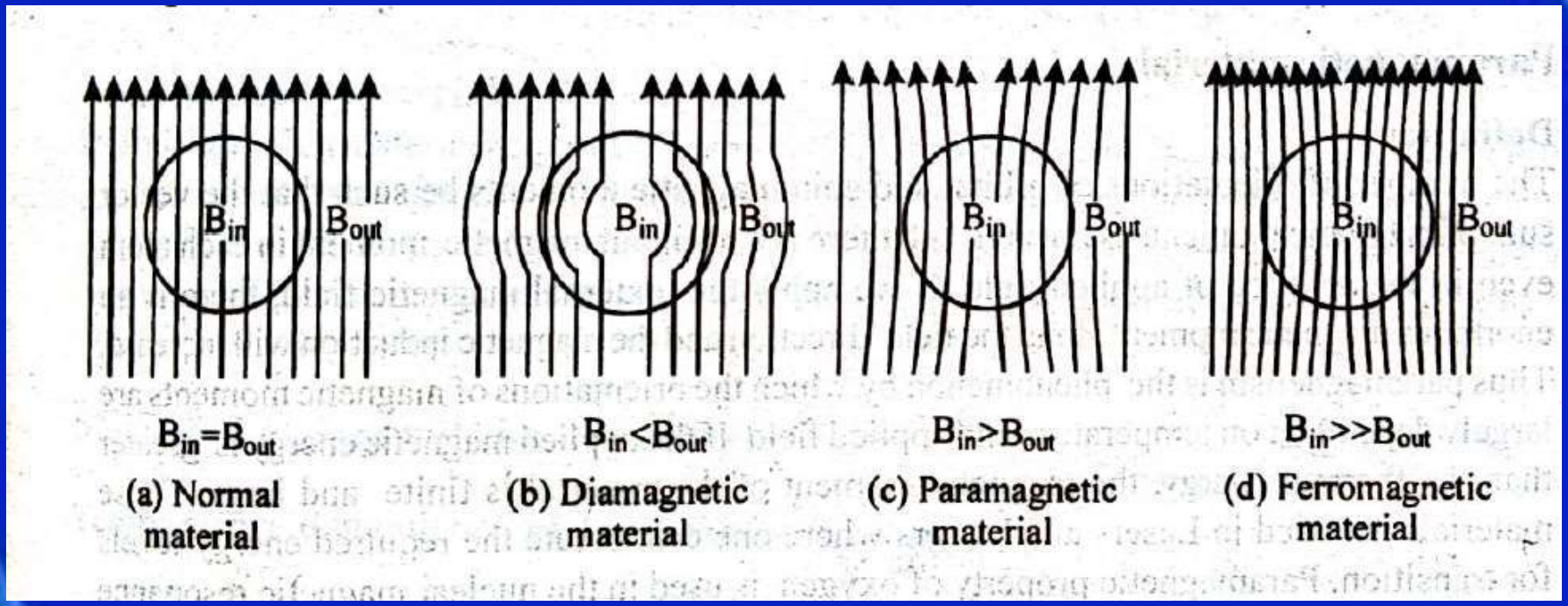
Magnetic Materials

- Electrons revolves around the positive nucleus- orbital magnetic moment
- Electrons rotate it self called spin – spin magnetic moment
- Materials which create self magnetic field in the presence of external magnetic field called magnetic materials
- Nearly 11 types
- Some of them are dia, para, ferro and antiferro


B_{in}
B_{out}
B_{in}
B_{out}
B_{in}
B_{out}
B_{in}
B_{out}
$B_{in}=B_{out}$
$B_{in}<B_{out}$
$B_{in}>B_{out}$
$B_{in}>>B_{out}$
(a) Normal material
(b) Diamagnetic material
(c) Paramagnetic material
(d) Ferromagnetic material

1. Diamagnetic materials

- The vector sum of magnetic moment is zero.
- Induced magnetic moment opposite direction of the applied field
- Negative susceptibility.
- No permanent magnetic moment.
- Repel magnetic lines of forces .
- No permanent dipoles magnetic effects are very small.
- Diamagnetic susceptibility is independent of temperature and applied magnetic filed strength.

2. Paramagnetic materials

- Vector sum of magnetic moment is not zero
- There is a net magnetic moment in the absence of applied magnetic field
- Field is applied produce anomalous moment in the field direction
- Magnetic moment depends on temperature and applied field
- Used in Lasers and Masers
- Attract magnetic lines of force
- Have Permanent dipoles
- Paramagnetic susceptibility independent of the applied field
- Depends only on temperature

3. Ferromagnetic materials

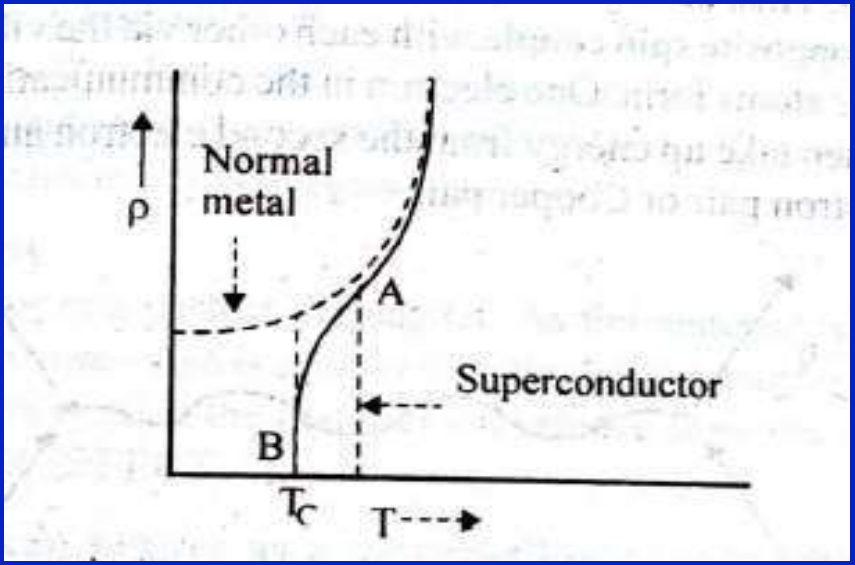
- High magnetisation in weak magnetic field
- Absence of field it have anomalous magnetic moment
- Spontaneous magnetisation
- Magnitude of susceptibility – very large and positive
- Example Fe, Ni, Co
- Large internal field permanent dipoles strongly aligned in the same direction and large spontaneous magnetisation
- Attract lines of force very strongly
- Exhibit magnetisation in the absence of magnetic field
- Loss their magnetisation slowly

4. Antiferromagnetic materials

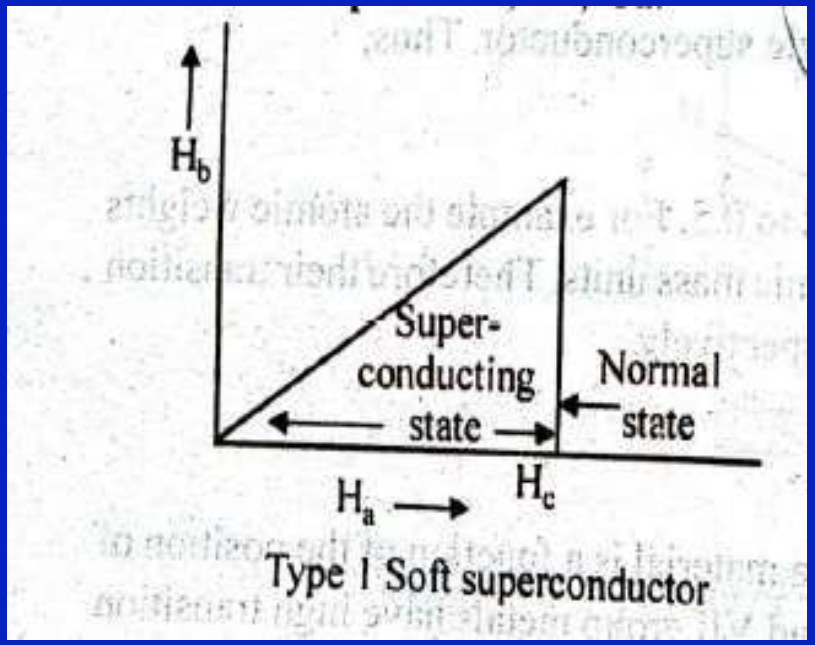
- Spin alignment in anti parallel manner with neighbouring spin
- So net magnetisation is zero
- Magnitude of susceptibility – small and positive
- Example FeO, MnO
- Opposite alignment in magnetic moment produces exchange interaction
- Initially susceptibility increases slightly with temperature up to particular limit
- Above a limit susceptibility decreases

Super Conductivity

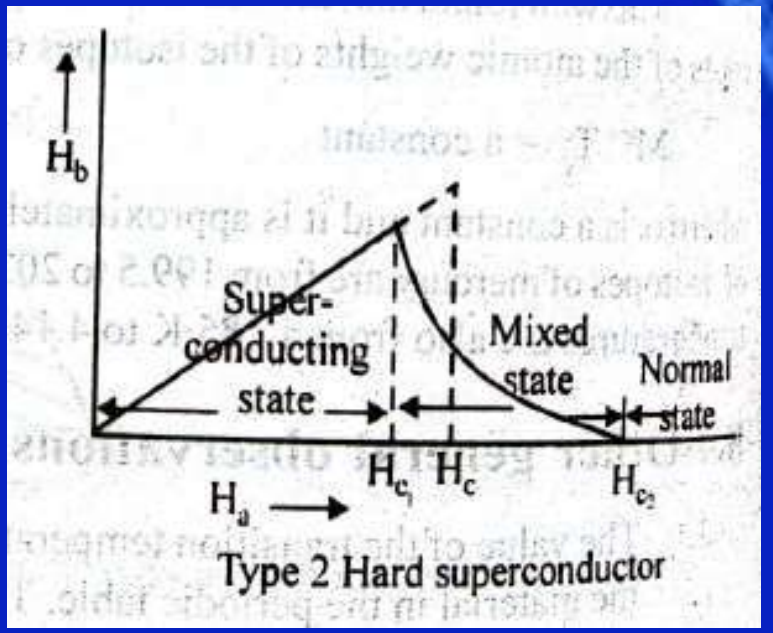
- The ability of certain substances to conduct electricity without resistance called superconductivity
- Substances which have this property are called superconductivity
- Tc- Superconducting transition temperature defined as a critical temperature at which the resistivity of a materials suddenly changed to zero



Types of Super conductors
Two types



Type I Soft superconductor



Type 2 Hard superconductor

H_a - applied external magnetic field and

H_b - magnetic filed produced by the induced superconducting currents when an external field is applied.

THANK YOU

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