Tutorial 3:

- Elements of superconductivity,
- Meissner effect,
- Josephson junctions and applications;
- Elementary ideas about high temperature superconductivity.

Q1:

A perfect conductor and a superconductor with $T_c \sim 10\ K$ are subjected to the following conditions :

(i) cooled under applied magnetic field to $4\ K$

(ii) cooled to $4\ K$ and then magnetic field is applied

with schematic diagrams, explain path of magnetic field lines in all these situations. 15

2013

Q2:

Show that the London equation $\vec{\nabla} \times \vec{J} = -\frac{1}{\mu_0 \lambda_L^2} \vec{B}$ or $\vec{j} = -\frac{C}{4\pi\lambda_L^2} \vec{A}$

leads to the Meissner effect. 15

2013

Q3:

Lead in the superconducting state has critical temperature of 6.2 K at zero magnetic field and a critical field of 0.064 MAm^{-1} at 0 K. Determine the critical field at 4 K. 10

2014

Q4:

Distinguish between a superconductor and perfect conductor. Explain what is a Cooper pair. 10

2015

Q5:

With the help of a schematic diagram, show how entropy and specific heat vary with temperature for a superconductor. *10*

2016

Q6:

Obtain the expression for penetration depth using London's equation of superconductivity and explain its significance. 10+5=15

2017

Q7:

What are type I and type II superconductors? Give examples. Discuss and compare Meissner effect and perfect diamagnetic behaviour for type I and type II superconductors. 20

2018

Q8:

Using the two-fluid model of a conductor (normal and superconducting) and the Maxwell's equations, derive the two London equations of superconductivity. 20

2020

Q9:

Explain why Type-II superconductor is better than Type-I superconductor in the application of superconductor magnets. 10

2022

Q10:

Compare the dependence of resistance on temperature of a superconductor with that of a normal conductor. Describe briefly the formation of Cooper pairs. 15

2022

Q11:

What is superconductivity ? Explain Meissner effect. Why superconductors should be a diamagnetic material ? 15

2023

Q12.

How does supercritical magnetic field depend on temperature ? For a superconducting specimen, the critical magnetic fields are respectively $1{\cdot}45 \times 10^5$ A/m and $4{\cdot}2 \times 10^5$ A/m for 14 K and 13 K. Determine the superconducting transition temperature and the critical field at 0 K. *10*

2024