Tutorial Sheet- unit 5 (Superconductors and Nano-Materials) - (2023-24)

Sub. Name: Engineering Physics **Sub. Code: BAS201**

Date of Issue: **Date of Submission:**

1. A long thin superconducting wire of a metal produces a magnetic field 105×10^3 A/m on its surface due to current passing through it at a certain temperature T K. Calculate T. Given $H_c(0) = 150 \times 10^3$ A/m and $T_c = 9.3$ K. [**Ans T = 5.03 K]**
2. For a specimen of V_3Ga, the critical fields are respectively 0.176 T and 0.528 T for 14K and 13K. Calculate the transition temperature and critical fields at 0K and 4.2K.
   [**Ans T_C = 14.5 K, $H_c(T)$ = 2.37 Tesla]**
3. The transition temperature for Pb is 7.2K. However, at 5K it loses the superconducting property subjected to a magnetic field of 3.3×10^4 A/m. Find the maximum value of magnetic field which allow the metal to retain its superconductivity at 0K**. (2017)**
   [**Ans $H_c(0) = 6.37 \times 10^4$ A/m]**
4. Determine the transition temperature and critical field at 4.2 K for a given specimen of superconductor if the critical fields are 1.410×10^5 A/m and 4.205×10^5 A/m at 14.1K and 12.9K respectively. [**Ans T_C = 14.67 K, $H_c(0) = 18.20 \times 10^5$ A/m, $H_c(T) = 17.31 \times 10^5$ A/m**]
5. A lead wire has a critical magnetic field of 6.5×10^3 A/m at 0K. The critical temperature is 7.18K. At what temperature the critical field would drop to 4.5×10^3 A/m ? The diameter of the wire is 2 mm. What is the critical current density at that temperature? **[Ans T = 3.98 K, $J_c = 9.0 \times 10^6$ A/m^2]**
6. Calculate the critical current which can flow through a long thin superconducting wire of diameter 10^{-3} m, given $H_c = 7.9 \times 10^3$ A/m. **[Ans: 24.81 Amp].**
7. Determine critical current and current density, which can flow through a long thin superconducting wire of diameter 2 mm if critical field for the material is 1.21×10^4 A/m. **(Ans: Ic = 75.98A, Jc = 2.42 x 10^6 A/m^2)**