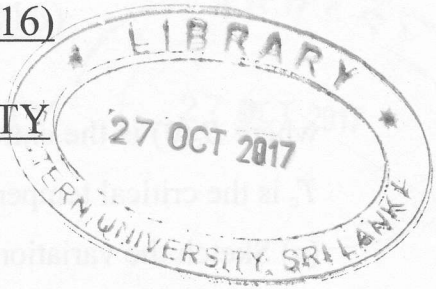# EASTERN UNIVERSITY, SRI LANKA

SPECIAL DEGREE EXAMINATION IN SCIENCE – 2012/2013

(SEPTEMBER/OCTOBER - 2016)

PHS 13 SUPERCONDUCTIVITY

e: 02 hour

wer **ALL** Questions

(a) Describe briefly the Meissner Effect as applied to the superconducting state.

(b) Define the critical magnetic field (H_c) of a superconductor and sketch the variation of the critical magnetic field (H_c) with temperature (T) for a superconductor.

(c) Distinguish between Type I and Type II superconductors giving examples for each case.

(d) Sketch the variation of magnetization (M) with applied magnetic field (B_a) for Type I and Type II superconductors.

Outline the main features of the BCS theory in explaining the phenomenon of uperconductivity in metals and alloys paying a particular attention to the following ses

a) the "electron-phonon interaction" and

b) "Isotope Effect".

c) according to the BCS theory of superconductivity, the value of the energy gap (in eV, at zero temperature) is given by $E_g = 3.5 \ kT_c$, where k is the Boltzmann constant and T_c is the critical temperature of the superconducting material.

Compute the value of E_g (in eV) for lead if $k = 8.62 \times 10^{-5}$ eV/K and T_c is 7.2 K for lead.

1

03. The temperature dependence of the critical field strength in a superconduc
approximately parabolic and given by the relation:

$$B_c(T) = B_c(0)\left[1 - \left(\frac{T}{T_c}\right)^2\right]$$

where $B_c(0)$ is the extrapolated value of the critical field strength at absolute ze
T_c is the critical temperature.

(a) Sketch the variation of $B_c(T)$ with T for a superconductor.

(b) For Nb_3Ge superconductor, the critical temperature T_c is 23.2 K and the
magnetic field at 0 K is $B_c(0) = 34.0$ Tesla. Calculate the critical magneti
for this material at 15 K.

04. (a) What are High Temperature Superconductors?

(b) Give the chemical compositions and approximate T_c values of four differe
temperature superconducting materials.

(c) How would you synthesize and characterize a sample of Y-Ba-CuO bas
temperature superconducting material in the laboratory?