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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016**

COURSE NAME : SUPERCONDUCTOR
COURSE CODE : BWC 40203
PROGRAMME : 4 BWC
EXAMINATION DATE : DECEMBER 2015/JANUARY 2016
DURATION : 3 HOURS
INSTRUCTION : (A) ANSWER ALL QUESTIONS
IN SECTION A
(B) ANSWER **ONE (1)**
QUESTION IN SECTION B

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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SECTION A

- Q1** (a) Each term given below refers to some superconductors concepts and properties. Distinguish between each pair of terms by referring to their definitions.
- (i) Superconductors and superconductivity;
 - (ii) Critical temperature and critical current density;
- (8 marks)
- (b) Using specific Maxwell's equation, show that a cooled superconductor (superconducting in zero magnetic field) does not behave like ideal conductors. (**Hint:** $\chi = -1$: perfect diamagnetism)
- (6 marks)
- (c) Explain the different between superconductors and normal conductor using appropriate diagram
- (6 marks)
- Q2** (a) Give a brief description that best fit each of the following terms and definitions.
- (i) Perfect conductor
 - (ii) Perfect diamagnetism
- (4 marks)
- (b) Describe the phenomena of Meissner effect using appropriate diagram.
- (8 marks)
- (c) Sketch the magnetization versus external magnetic field for a Type I and a Type II superconductor. Compare the different between Type I and Type II superconductors.
- (8 marks)
- Q3** (a) Analyse coherence length using suitable diagram.
- (6 marks)

- (b) Sketch the I - V diagram for AC and DC Josephson effect. Briefly discuss the difference between AC and DC Josephson effect. (8 marks)
- (c) Plot the I - V diagram for NIN, NIS and SIS. (6 marks)
- Q4** (a) Differentiate the theory introduced by “London” and “Ginzburg-Landau”. (4 marks)
- (b) Explain the “BCS” theory and include appropriate diagram in your explanation. (6 marks)
- (c) Compare the specific heat, c_v in a normal conductor at low temperature by considering the electron from conduction band and the lattice. (6 marks)
- (d) Sketch the specific heat, c_v versus temperature, T for a metal in normal and superconducting state at zero magnetic field. (4 marks)

SECTION B

- Q5** (a) Sketch the inverse of magnetic susceptibility ($1/\chi$) versus temperature (T) for ferromagnetic, paramagnetic and antiferromagnetic behaviour in the same diagram. Write the three equations that govern them all. (10 marks)
- (b) Briefly explain the following application:
(i) Magnets for magnetic resonance imaging, MRI
(ii) Magnets for magnetically levitated trains, MAGLEV (10 marks)
- Q6** Select a suitable technique to prepare the high temperature superconductor (HTSC) of $\text{YBa}_2\text{Cu}_3\text{O}_7$ (YBCO) and construct a flow chart based on the preparation technique used. (20 marks)

– END OF QUESTION –