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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022**

COURSE NAME : SUPERCONDUCTOR
COURSE CODE : BWC 40203
PROGRAMME CODE : BWC
EXAMINATION DATE : JANUARY/FEBRUARY 2022
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER ALL QUESTIONS.
2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**.

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

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Q1 There are many areas of technology today, where superconducting material is used. These include in the field of transportation, medical equipment, research instruments and computers.

- (a) List **FIVE (5)** examples of technology or instruments where superconductors are used. (5 marks)
- (b) Choose one of the above example, and explain how superconductor (material or device) is used in industrial applications. (5 marks)
- (c) Superconductivity was discovered by Kemerling Onnes in 1911; more than 100 years ago. Besides various application available today, the wide spread use of superconductor is yet to be discovered. Give your views on the current situation, based on physics and current technological development. (10 marks)

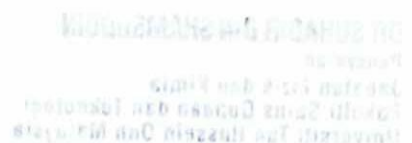
Q2 (a) Explain the difference between a semiconductor (e.g. silicon) and a superconductor (e.g. lead). (5 marks)

(b) How do you determine if a superconducting crystal is type I or type II?. (5 marks)

(c) Using a magnetometer, you are measuring experimentally, the magnetization of superconductors, type I and type II. Explain the experimental procedure, and plot a diagram to show the magnetization and applied field for type I and type II superconductors. (10 marks)

Q3 (a) Define the following terms and definitions.

- (i) Superconductors, (2 marks)
- (ii) Perfect diamagnetism, (2 marks)
- (iii) Critical temperature. (2 marks)



- (b) Josephson junction is the phenomenon of supercurrent which also known as Josephson effect. Differentiate between AC and DC Josephson effects and then sketch the I - V diagram for both effects.
(8 marks)
- (c) Explain the term of metal-insulator-metal (MIM), metal-insulator-superconductor (NIS) and superconductor-insulator-superconductor (SIS). Sketch the I - V diagram for each terminology.
(6 marks)
- Q4** (a) Relate the London equation using Newton second law of motion and Maxwell interpretation.
(10 marks)
- (b) Bardeen-Cooper-Schrieffer (BCS) theory was the first microscopic theory of superconductivity. Using appropriate diagram, describe this BCS theory.
(6 marks)
- (c) Meissner effect is a phenomena related to the superconductivity. Using appropriate diagram, describe the phenomena of Meissner effect.
(4 marks)
- Q5** (a) Identify the effect of elemental substitution on the crystal structure, electrical and magnetic properties of high temperature superconductor. Illustrate a suitable diagram to show the effectiveness of the substitution.
(10 marks)
- (b) Using suitable sample preparation method, outline the flow chart for the synthesis of high temperature superconductivity of $\text{YBa}_2\text{Cu}_3\text{O}_7$ (YBCO).
(10 marks)

– END OF QUESTIONS –