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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021**

COURSE NAME : SUPERCONDUCTOR
COURSE CODE : BWC 40203
PROGRAMME CODE : BWC
EXAMINATION DATE : JANUARY/FEBRUARY 2021
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTION
OPEN BOOK EXAMINATION

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

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- Q1**
- (a) Superconductor material was first discovered by Dutch scientist, Heike Kamerlingh Onnes in 1911. Discuss his main finding. (8 marks)
 - (b) $\text{YBa}_2\text{Cu}_3\text{O}_7$ (YBCO) was the most famous superconductor and discovered by scientist from China. Please state the name of the scientist who found this material and the main properties of this particular material. (6 marks)
 - (c) Using appropriate diagram, explain Bardeen-Cooper-Schrieffer theory which was the first microscopic theory of superconductivity. (6 marks)
- Q2**
- (a) Define the following terms;
 - (i) Perfect diamagnetism. (2 marks)
 - (ii) Critical current density. (2 marks)
 - (iii) Critical temperature. (2 marks)
 - (b) Distinguish non superconductor and superconductor material. Identify **TWO (2)** factors that could be affecting the superconductivity. (8 marks)
 - (c) Meissner effect was a phenomena related to the superconductivity. Using appropriate diagram, explain the phenomena. (6 marks)
- Q3**
- (a) Point out 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) The applications of superconductor can be useful in several areas such as medicine and transportation. Describe in detail **TWO (2)** examples of application that relate to these areas. (10 marks)

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- Q4** (a) Josephson junction is the phenomenon of supercurrent which also known as Josephson effect. Differentiate between AC and DC Josephson effect and then sketch the I - V diagram for both effects. (8 marks)
- (b) Sketch the graph of inverse magnetic susceptibility ($1/\chi$) versus temperature (T) for ferromagnetic, paramagnetic and antiferromagnetic behaviour in the same diagram. (6 marks)
- (c) The transition temperature, T_C of a superconductor is inversely proportional to the power of mass ions of the lattice, $M^{\frac{1}{2}}$. Calculate the transition temperature for sample of ^{201}Hg , ^{202}Hg and ^{204}Hg , if the transition temperature for ordinary mercury is 4.143 K for an average atomic mass of 200.59 u. (6 marks)
- Q5** (a) Differentiate with examples, the Type I and Type II superconductor. (4 marks)
- (b) High temperature superconductor can be prepared using a few preparation methods such as solid state reaction and sol gel methods. Differentiate these **TWO (2)** methods in terms of sample preparation. (8 marks)
- (c) State the equipment which can be used to determine the electrical and magnetic properties of high temperature superconductor. Using appropriate diagram, describe how the equipment is operated at low temperature condition. (8 marks)

– END OF QUESTIONS –