Exam Date & Time: 10-Jul-2023 (02:30 PM - 05:30 PM)



## MANIPAL ACADEMY OF HIGHER EDUCATION

## END SEMESTER MAKEUP B.TECH EXAMINATIONS, 2023 MATERIAL SCIENCE FOR BIOMEDICAL ENGINEERS [BME 4054]

## Marks: 50

**Duration: 180 mins.** 

A

## Answer all the questions.

Instructions to Candidates: Answer ALL questions

- 1) Illustrate the changes in the potential energy of sodium and Chlorine atoms in sodium chloride with respect to the separation between them. Assume that single sodium and chlorine atoms are present, and no other forces are acting on them. (2)
  - A)

A)

- B) "At intrinsic temperature range the electrical conductivity of n-type semiconductors increases with increase in temperature". Decide if this statement is correct or wrong. Justify your decision. (3)
- C) Compare the temperature dependence of resistivity for a pure metal, two-metal alloy and two metal alloy with defects. Justify your answer. (5)
- 2) Deduce the polarizations present in NaCl (sodium chloride), considering NaCl is an ionic dielectric material without any permanent dipoles.

(2)

- B) Explain the limitations of Townsend's theory for dielectric breakdown. (3)
- C) A student prepared an experiment set up. The set up consists of two metallic electrodes (anode & cathode) placed at specific distance in a closed airtight box. The box is filled with argon gas.

As a part of the experiment procedure, student started increasing the voltage applied to the electrodes. Propose the dielectric breakdown of air in this box, based on Streamer mechanism

(5)



3) Explain in detail the magnetic properties of ferrimagnetic materials.

|    |    |  | (2) |
|----|----|--|-----|
|    | A) |  |     |
|    | B) | Describe in detail the magnetic properties of paramagnetic materials.  | (3) |
|    | C) | A piece of wood is placed in between an anode and cathode. Salt solution is drizzled<br>over the wood. After that the voltage applied to the electrodes slowly increased. Predict<br>the possible dielectric breakdown with detailed explanation.                          | (5) |
| 4) |    | Discuss the contribution of nuclear spin on the permanent magnetic moment of an atom.  |     |
|    |    |  | (2) |
|    | A) |  |     |
|    | B) | Explain importance of Neel temperature in anti-ferromagnetic materials   | (3) |
|    | C) | Propose a mechanism to obtain higher energy photon from a material by exciting it with a lower energy photon. Justify the answer.  | (5) |
| 5) |    | Compare ferroelectricity and piezoelectricity.   |     |
|    |    |  | (2) |
|    | A) |  |     |
|    | B) | Explain the properties of Type I superconducting materials   | (3) |
|    | C) | A researcher is reducing the size of a ferromagnetic material by griding. The single magnetic domain size of the material is around 20 nm. Speculate the changes in the magnetic properties of the material as the size of the material approaches the single domain size. | (5) |

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