

SARDAR VALLABHBHAI NATIONAL INSTITUTE OF TECHNOLOGY

SURAT-395 007

END SEMESTER EXAM, JULY-2020

B. Tech. I (All branches) PH 113 S2: Physics of Materials and Nuclei

Duration: 2 hour

Total Marks: [30]

Instructions:

- 1. All questions are compulsory**
- 2. Assume suitable data wherever necessary (specify them in your answers)**
- 3. All answers of Q1 must be cover up on page no.1 & 2 and Q2 on page no. 3-6 only. Upload your answer sheet with not more than SIX pages.**
- 4. The file name of the scanned answer book must be your “enrolment number_PMN”**
- 5. Write your enrolment number and sign on every page of the answer book**
- 6. In case of loss of internet connection or technical error, don't panic. Keep calm and try again.**

Q. 1 Write the answers of following questions. [1-16×1=16, 17-18×2=4]

[20]

1. If $(h\ k\ l)$ are the Miller indices of a plane, then the plane cuts the axes into h , k and l equal segments
(a) yes (b) no
2. Minimum interplanar spacing required for Bragg's diffraction is:
(a) $\lambda/4$ (b) $\lambda/2$ (c) λ (d) 2λ
3. The susceptibility of a diamagnetic material is essentially independent of temperature....
(a) under all circumstances
(b) as long as the electronic structure is independent of temperature
(c) at very low temperature of 10 K
(d) at very high temperature
4. Example for paramagnetic materials.....
(a) super conductors (b) alkali metals (c) transition metals (d) Ferrites
5. Which of the following is type II superconductor
(a) Hg (b) Pb (c) Al (d) Nb
6. The collision time and the root mean square velocity of the electron at room temperature are 2.5×10^{-14} s and 1×10^5 m/s respectively. The classical value of mean free path of electron is....
(a) 2.5 nm (b) 2.5 \AA (c) 2.5×10^{19} nm (d) 100 nm
7. When the outermost orbit of an atom has exactly 4 valence electrons, the material is generally.....
(a) a metal (b) a non-metal (c) a semiconductor (d) an insulator
8. In a semiconductor, the energy gap between valence and conduction bands is about
(a) 15 eV (b) 100 eV (c) 1 eV
9. A pentavalent impurity has valence electrons.
(a) 3 (b) 5 (c) 4 (d) 6
10. In the Hall Effect, the electric field is in X direction and the velocity is in Y direction. What is the direction of the magnetic field?
(a) X (b) Y (c) Z (d) XY plane

- 11 When a free electron recombines with a hole, there results.....
 (a) generation of energy gap (b) release of energy (c) no change of energy (d) all of the above
- 12 The charge carrier of strong interaction is.....
 (a) **Gluon with spin=1** (b) Gluon with spin=0 (c) Gluon with spin=1/2 (d) Higgs Boson
- 13 In quantum electrodynamics (QED), electromagnetic forces are mediated by.....
 (a) Hadrons (b) action at a distance (c) the weak nuclear interaction
 (d) **the exchange of virtual photons**
- 14 Which of the following choices list the four types of forces in nature in order of decreasing strength?
 (a) **strong nuclear, electromagnetic, weak nuclear, gravitational**
 (b) electromagnetic, strong nuclear, weak nuclear, gravitational
 (c) strong nuclear, gravitational, weak nuclear, electromagnetic
 (d) strong nuclear, weak nuclear, electromagnetic, gravitational
- 15 Particles that participate in the strong nuclear interaction are known as.....
 (a) Neutrinos (b) **hadrons** (c) leptons (d) electrons
- 16 Why are nuclear energy levels more complex than electron energy levels?
 (a) Nuclear energy levels depend only on attractive forces.
 (b) **Nuclear energy levels depend on attractive and repulsive forces.**
 (c) Nuclear energy levels are an order of one hundred times as great as electron energy levels.
 (d) Electron energy levels depend on the interaction between neutrons and electrons.
- 17 A copper wire of length 0.5 meter and diameter 0.3 mm has a resistance $0.12 \, \Omega$ at 20°C . If the thermal conductivity of copper at 20°C is $390 \, \text{W m}^{-1} \text{K}^{-1}$, the value of Lorentz number..... [2]
 (a) $1.12 \times 10^{-8} \, \text{W}\Omega\text{K}^{-2}$ (b) **$2.26 \times 10^{-8} \, \text{W}\Omega\text{K}^{-2}$** (c) $2.26 \times 10^{-8} \, \text{W}\Omega\text{K}^2$ (d) $1.12 \times 10^{-8} \, \text{W}\Omega\text{K}^2$
- 18 A magnetic material has a magnetization of $3200 \, \text{A/m}$ and flux density $0.005 \, \text{weber/m}^2$. Value of the magnetizing force is..... and the relative permeability of the material is.....[2]
 (a) $750 \, \text{A/m}$ & 5 (b) $700 \, \text{A/m}$ & 4.5 (c) $780 \, \text{A/m}$ & 5.5 (d) $800 \, \text{A/m}$ & 5

Q. 2 Write the answers of following questions. (any two) [10]

1. What are the assumptions introduced by Drude-Lorentz to explain classical free electron theory of metals? Discuss the achievements and failures of this model.
2. Distinguish between insulator, semiconductor and conductor on the basis of energy band theory. The Intrinsic carrier density at room temperature in Ge is $2.37 \times 10^{19} \, \text{m}^{-3}$ if the electron and hole mobilities are 0.38 and $0.18 \, \text{m}^2 \text{V}^{-1}\text{s}^{-1}$ respectively, calculate the resistivity.
3. What is an ensemble? Classify different statistical ensembles.

.....**All The Best**.....