Started on	Sunday, 19 September 2021, 2:00 PM
State	Finished
Completed on	Sunday, 19 September 2021, 3:43 PM
Time taken	1 hour 42 mins
Grade	**33.50** out of 35.00 (**96**%)

Question 1

Complete

Mark 5.00 out of 5.00

(a) What do you understand by phonons? Explain the concept of acoustic and optical waves. (2)

(b) The magnetic field intensity of a piece of iron oxide is 10^5 A/m and the susceptibility at room temperature is 0.0003. Find the magnetic flux density in the material. (3)

$\mu_0=4\pi\times10^{-7}$ H/m, $\varepsilon_0=8.8\times10^{-12}$ F/m

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Question 2

Complete

Mark 5.00 out of 5.00

(a) How to distinguish between ferromagnetic and antiferromagnetic materials experimentally? (2)

(b) Describe the magnetic anisotropy with one example. Explain its physical origin. (3)

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Question 3

Complete

Mark 2.50 out of 4.00

(a) Discuss how energy bands are formed. Show with diagram for at least five atoms and up to n=3 levels. (3)

(b) Which of the following is (are) true? (1)

(A) DC electrical conductivity of metals increases with electron density and relaxation time.

(B) DC electrical conductivity of metals decreases with electron density and relaxation time.

(C) DC electrical conductivity of metals increases with electron density but decreases with relaxation time.

(D) DC electrical conductivity of metals decreases with electron density but increases with relaxation time.

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diagram missing

Question 4

Complete

Mark 5.00 out of 5.00

(a) Explain how to find direct and indirect band gap in a semiconducting material. (2)

(b) The thermoelectric power of the thermocouple pair is 300 μV/K and the temperature different is 100K. How much voltage can be generated in this case? (1)

(c) Write four applications of thermoelectric module. (2)

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Question 5

Complete

Mark 6.00 out of 6.00

Using Kronig-Penny model, show that the energy spectrum of an electron consists of several allowed energy bands separated by forbidden regions. Discuss in detail including the limiting cases of very weak and strong potentials.

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Question 6

Complete

Mark 5.00 out of 5.00

(a) Consider a bar magnet of length *l* and strength *p* on each pole placed at an angle 45^{o} with respect to a uniform field of 10 Oe. Find the magnetic moment of the bar magnet. (2)

(b) Draw the M-H curve for paramagnetic substance at three different temperatures and explain the behavior in detail. (3)

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Question 7

Complete

Mark 5.00 out of 5.00

The energy-wave vector dispersion relation for a one dimensional of lattice parameter *a* is given by the following equation:

$E(k)=E_0-\alpha-2\beta\cos ka$

(a) Find the value of *k* at which the energy of the electron is maximum. (2)

(b) Find the effective mass of the electron at bottom and at top of the band in first Brillouin Zone. (3)

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