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	Sanjay Ghodawat University, Kolhapur Established as State Private University under Govt. of Maharashtra. Act No XL, 2017	2017-18
FY M. Sc.	School of Science	Semester II
PHS 502	Condensed Matter Physics	Max Marks: 100
May 2018	End Semester Examination (ESE)	Time: 3 Hrs.

22/5/18 Time: 10:30 AM to 1:30 PM.

- Instructions for Students:**
- 1) All questions are compulsory.
 - 2) Figures to the right indicate full marks.
 - 3) Use of scientific calculator is allowed.

		Marks	CO
Q.1	Choose the correct alternative	20	
a)	Relation between atomic radius r and lattice constant a in the case of BCC lattice is (i) $r = a/2$ ii) $r = (\sqrt{2}/4).a$ iii) $r = (\sqrt{3}/4).a$ iv) $r = 4a$	01	PHS502.1
b)	In a crystal if the primitives $a = b = c$ and interfacial angles $\alpha = \beta = \gamma = 90^\circ$, then it belongs to the system.... i) cubic ii) trigonal iii) tetragonal iv) triclinic	01	PHS502.1
c)	The Miller index of the plane parallel to the x -axis and y -axis is.... i) (100) ii) (010) iii) (001) iv) (111)	01	PHS502.1
d)	A cation vacancy and an anion vacancy in a crystal is called... i) Schottky defect ii) Frenkel defect iii) dislocation iv) interstitial	01	PHS502.1
e)	Among the following the strongest bond is i) hydrogen bond ii) metallic bond iii) covalent bond iv) ionic bond	01	PHS502.2
f)	Metallic solid are generally i) hard and brittle ii) malleable and ductile iii) soft and plastically deformable iv) none of these	01	PHS502.2
g)	X-rays are frequently used for crystal analysis using the physical phenomena of i) interference ii) diffraction iii) polarization iv) none of these	01	PHS502.2
h)	Bragg usedradiation to study diffraction by crystals. i) laser ii) uv iii) visible iv) X-ray	01	PHS502.2
i)	When the band gap is in the order of 1 eV in a solid, it behaves as a ... i) conductor ii) semiconductor iii) metal iv) insulator	01	PHS502.2

- j) Conductivity of semiconductor increases with 01 PHS502.2
 i) increase in temperature ii) decrease in temperature
 iii) constant temperature iv) none of these
- k) The critical magnetic field is that at which..... 01 PHS502.3
 i) a material behaves as a normal conductor for last time.
 ii) a material maintains its superconductivity for the last time
 iii) a material has its mixed normal – superconducting state
 iv) a material transforms from superconducting state to normal state
- l) The critical temperature is that temperature where..... 01 PHS502.3
 i) resistivity of a superconducting material drops to zero
 ii) current flowing through a superconductor is minimum
 iii) magnetic field inside a superconductor becomes constant
 iv) none of these
- m) The periodicity of lattice is given by ... 01 PHS502.3
 i) Bloch theorem ii) Plank theorem
 iii) Lorentz theorem iv) none of these
- n) Donor type impurities are the materials of..... 01 PHS502.3
 i) III group of periodic table ii) IV group of periodic table
 iii) V group of periodic table iv) none of these
- o) In dielectric the polarization is 01 PHS502.4
 i) linear function of the applied electric field
 ii) square function of the applied electric field
 iii) exponential function of the applied electric field
 iv) none of these
- p) The relation between dielectric constant (ϵ_r) and electric susceptibility (χ_e) is 01 PHS502.4
 i) $\chi_e = \epsilon_0 (\epsilon_r - 1)$ ii) $\chi_e = \epsilon_r \epsilon_0$ iii) $\chi_e = \epsilon_r / \epsilon_0$ iv) $\chi_e = \epsilon_0 (\epsilon_r - 1) E$
- q) Polarization is defined as 01 PHS502.4
 i) dipole moment per unit volume ii) surface charge density
 iii) dipole moment per unit area iv) none of these
- r) Ferromagnetic substances have 01 PHS502.4
 i) high permeability and low susceptibility
 ii) low permeability and high susceptibility
 iii) low permeability and low susceptibility
 iv) high permeability and high susceptibility

s) The susceptibility of paramagnetic substance is 01 PHS502.4
 i) negative ii) positive iii) zero iv) none of these

t) Diamagnetic substances when placed in a magnetic field are.... 01 PHS502.4
 i) strongly attracted ii) repelled
 iii) weakly attracted iv) neither attracted nor repelled

Q.2 Answer the following questions. 20 PHS502.1

a) Explain in brief defects in crystals. 12 PHS502.1
 b) Define Miller index. Give the procedure to find Miller index of a plane. Give features of it. Draw (111) and (011) Miller planes. 08 PHS502.1

OR

b) i) Explain various Bravais lattices in two dimensional lattices. 04 PHS502.1
 ii) A substance with FCC lattice has density 6250 Kg/m^3 and molecular weight 60.2. Calculate lattice constant "a". (Avogadro's number = $6.02 \times 10^{26} \text{ Kg/mole}$). 04 PHS502.1

Q.3 Answer the following questions. 20 PHS502.2

a) With suitable diagram explain the construction and working of Bragg's X-ray spectrometer. State and derive Bragg's law. 12 PHS502.2
 b) Explain the ionic and covalent bonding in solids with suitable examples. 08 PHS502.2

OR

b) i) The Bragg's angle corresponding to the first order reflection from the plane of crystal is 30° , when the X-rays of wavelength 1.78 \AA are used. Calculate the interplanar spacing. 04 PHS502.2
 ii) Calculate glancing angle for a cubic (100) crystal of rock salt ($a = 2.814 \text{ \AA}$) corresponding to second order diffraction maximum for X-rays of wavelength 0.710 \AA . 04 PHS502.2

Q.4 Answer the following questions. 20 PHS502.3

a) Explain Type -I and type -II superconductors. Mention any two properties of superconductors. 12 PHS502.3
 b) On the basis of band theory how the crystalline solids are classified into conductors, semiconductors and insulators. 08 PHS502.3

OR

b) i) Write applications of superconductors.

ii) For intrinsic silicon, the room temperature electrical conductivity is 4×10^{-4} mho/m. The electron and hole motilities are $0.14 \text{ m}^2/\text{V}\cdot\text{s}$ and $0.040 \text{ m}^2/\text{V}\cdot\text{s}$, respectively. Compute the electron and hole concentration at room temperature.

Q.5 Answer the following questions.

a) Obtain Clausius- Mossotti equation and Debye equation.

b) What are ferromagnetic materials?

OR

b) i) Write applications of magnetic materials.

ii) If an ionic crystal is subjected to an electric field of 2000 V/m and the resulting polarization is $6.4 \times 10^{-8} \text{ C/m}^2$, then calculate the relative permittivity or the dielectric constant of the crystal.
(Given: $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N/m}^2$).
