DQ-003-1016032 Seat No. _____

B. Sc. (Sem. VI) (CBCS) (W.E.F. 2016) Examination

April - 2022

Physics : 602

(Statistics Mech. & Solid Statephy)

(New Course)

Faculty Code : 003

Subject Code : 1016032

Time : **2.30** Hours] [Total Marks : **70**

Instruction : (1) All questions are compulsory.
(2) Symbols have their usual meanings.
(3) Figures to the right indicate marks.

Physical Constant :

$h = 6.62 \times 10^{-34} JS$; $\hbar = 1.055 \times 10^{-34} JS$

Boltzmann constant $K = 1.38 \times 10^{-23} J/k$

$R = 8.3 J\ mol^{-1} k^{-1}$

Mass of an electron $= 9.1 \times 10^{-31} kg.$

1 (a) Answer the following objective questions : **4**

(1) Phase space is _____ dimensional space.

(2) M-B statistics is applicable to particles which are identical and distinguishable. True/False.

(3) 'Fermions' are identical and indistinquishable with _____ spin.

(4) At high temperature B-E distribution approaches to M-B distribution. Ture/False.

(b) Answer any one question. **2**

(1) If 3 particles are arranged in a energy level, which having degeneracy gi = 4. Find the number of ways in Fermi-Dirac Statistics.

(2) Using uncertaintly principle show that the minimum volume of a cell in a phase space is h^3.

(c) Answer any one question. **3**

(1) State and prove sterling's theorem.

(2) Explain thermodynamic probability.

(d) Answer any one question in detail. **5**

(1) Derive Maxwell-Boltzmann distribution law.

(2) Explain microstates and macrostate.

2 (a) Answer the following objective questions : **4**

(1) In covalent bond, spins of two electrons are parallel. Do you agree ?

(2) The specific heat at constant pressure is $C_P = \left(\frac{\partial W}{\partial T}\right)_P$. Ture or False.

(3) Define unit cell.

(4) The co-ordination number of bcc structure is 8. True or False.

(b) Answer any one question. **2**

(1) Sketch the diagram showing cubic crustal having Miller indices (001).

(2) Debye temperature of carbon (Diamond) structure is 1850 k. Calculate the molar specific heat for diamond at 20 k.

(c) Answer any one question. **3**

(1) Explain body centred cubic (BCC) structure.

(2) Explain Metallic crystal.

(d) Answer any one question in detail. **5**

(1) Explain thermal conductivity

(2) Explain crystal plane and Miller indices.

3 (a) Answer the following objective questions : **4**

(1) Define : Fermi energy.

(2) Work function (ϕ) of metal is $\phi = E_s - E_f = hf_o$. True or False.

(3) Free electron gas in a metal can be considered as dense plasma. True or False.

(4) Fermi function f(E) = o for all values of E > Ef. Do you agree ?

(b) Answer any one question. **2**

(1) The Fermi energy of silver is 5.51 ev. What is the speed of the electron with this energy ?

(2) For free electron gas, using Fermi-Dirac distribution law show that $f(E) = 1/2$ for electron having energy $E = E_f$.

(c) Answer any one question. **3**

(1) Explain : Thermal capacity of free electron system.

(2) Derive Biltzmann equation.

(d) Answer any one in detail. **5**

(1) Explain : Hall effect.

(2) Describe free electron gas in one dimension.

4 (a) Answer the following objective questions : **4**

(1) Low electric conductivity of insulator is due to the banding and not to the binding of electrons.

True or False.

(2) The only difference between insulator and semi conductor is the magnitude of the forbidden band Eg at $T = 0^o$ k. True or False.

(3) Give a name of any donor imurity.

(4) In intrinsic semi conductors the Fermi level lies exactly half way between valance band and conduction band at OK. Do you agree ?

(b) Answer any one question. **2**

(1) Find free electons concentration (ne) in N-rigion of germmanium P-n junction if its conductivity (σe) is 2000 $(\Omega\,m)^{-1}$ and mobility of electron (μe) is 0.4 m^2 $(V–S)^{-1}$.

(2) The band gap of alloys semi conductors gallium arsenide phosphide is 1.98 ev. Calculate wavelength of radiation that is emitted when electrons and hole in this material recombine directly. Mention the colour of the emitted radiation.

(c) Answer any one question. **3**

(1) Explain interinsic semi conductor.

(2) Discuss bonding in semi conductor.

(d) Answer any one in detail. **5**

(1) Explain electron hole carrier in semi conductors.

(2) Explain : Insulator.

5 (a) Answer the following objective questions : **4**

(1) BCS theory is base on quantum principle. True or False.

(2) When we decrease the temperature of all metals and alloys the electrical resistivity also increase.

Ture or False.

(3) The magnetic susceptibility χ is -1 for a perfect diamagnetic material. True or False.

(4) For alloys, the transition temperature is extremely high. Do you agree ?

(b) Answer any one question. **2**

(1) Critical temperature of mercury with isotopic mass 199.5 is 4.185 k. Calculate its critical temperature, when its isotopic mass change to 203.4.

(2) For a specimen of V_3G_a, initial field is 20.7×10^5 amp/ m with initial temperature 4.2 k. Calculate critical field at critical temperature 14.5 k.

(c) Answer any one question. **3**

(1) Write five properties which do not change in super conducting transition.

(2) Explain Meissner effect.

(d) Answer any one in detail. **5**

(1) Explain the BCS theory.

(2) Explain the London theory.

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