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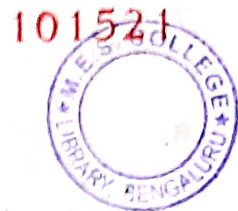
V Semester B.Sc. Examination, December - 2019
(CBCS) (F+R) (2018-19 and Onwards)
PHYSICS - V
Statistical Physics, Quantum Mechanics-I, Atmospheric Physics And Nano-material

Time : 3 Hours   Max. Marks : 70

Instruction : *Answer **any five** questions from **each** Part.*

PART - A

Answer **any five** of the following. Each question carries **8** marks.   **5x8=40**

Note :   Non-programmable scientific calculators are permitted.

1. (a) Define the terms microstate and phase-space for a thermodynamic   2+6
         system.

    (b) Derive the Maxwell-Boltzmann distribution law $n_i = g_i e - (\alpha + \beta^{Ei})$.

2. What are bosons ? Derive Bose-Einstein's distribution law.   **1+7**

3. Give an account of the failure of classical physics to explain :   **4+4**

    (a) Photoelectric effect and

    (b) Atomic spectra

4. (a) From Planck's law of radiation, arrive at Rayleigh-Jean's law for energy   3+5
         distribution in the blackbody spectrum.

    (b) Derive expression for the de Broglie wavelength in terms of energy of a
         non-relativistic particle.

5. Explain the construction and theory of Thomson's experiment, with a neat   **7+1**
    diagram. What is the significance of the result ?

6. (a) Define the terms group velocity and phase velocity. Derive relation   **5+3**
         between them.

    (b) Give any two mathematical forms of the Heisenberg's uncertainty
         principle. What is the physical significance of the principle ?

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7. Based on the vertical distribution of temperature, explain the formation of different layers in earth's atmosphere.

8. (a) What is "greenhouse effect" ? Mention any two greenhouse gases.
(b) Write a short note on Carbon nano-tube and Graphene.

PART - B

Answer **any five** of the following. Each question carries **4** marks.   **5x4=20**
Common data :
$h = 6.625 \times 10^{-34}$ Js, $C = 3 \times 10^8$ ms^{-1}, $m_e = 9.1 \times 10^{-31}$ kg, $m_n = 1.67 \times 10^{-27}$ kg, $m_p = 1.67 \times 10^{-27}$ kg

9. A system has two particles 'x' and 'y'. Using appropriate diagram, show how **2+2** they can be arranged in three quantum states according to :
(a) M B distribution and
(b) F D distribution

10. The free electron density of silver and aluminium are 5.85×10^{28} m^{-3} and 1.8×10^{29} m^{-3}, respectively. Find the Fermi energy of silver, given fermi energy of aluminium is 11.63 eV.

11. Five bosons have to be distributed in two compartments having 3 and 4 cells **2+2** respectively. Find the thermodynamic probability for the macro state (4, 1) and (5, 0).

12. UV radiation has wavelength 234 nm. Find its frequency and energy (eV). **2+2**

13. For proton and electron to have same de Broglie wavelength, compare their speeds.

14. Calculate the earth's atmospheric pressure at an altitude of 1 km. Given $R = 8.31$ Jmol^{-1}K^{-1}, $g = 9.8$ ms^{-2}, $t = 12°C$, Mean molar mass of air $= \mu = 29$ g/mol and 1 atm pressure $= 1.013 \times 10^5$ Pa.

15. A layer in the earth's atmosphere has thickness 225 m, density 0.15 kg m^{-3} on which radiation is incident at angle 65°. Calculate the absorbance and the optical thickness of the layer.

16. Find the total mass of air present in the earth's atmosphere. Assume pressure of air at mean sea level $= 1.013 \times 10^{15}$ Pa, $g = 9.8$ ms^{-2} and the radius of earth $= 6400$ km.

PART - C

Answer **any five** of the following. Each question carries **2** marks. **5x2=10**

17. (a) The isotopes $_2He^3$ and $_2He^4$ obey which distribution law at low temperature ?

    (b) In metals, what is the occupation index :

    (i) Below Fermi energy and

    (ii) Above Fermi energy.

    (c) Can we use M-B statistics to explain the properties of photon gas ?

    (d) Two particles have same mass and speed, with one of them charged and the other neutral. Can they have same de Broglie wavelength ? Justify your answer.

    (e) Wave nature of matter is not observed in bulk bodies. Why ?

    (f) 'Quantum dot is zero dimensional'. Justify.

    (g) Electrically and thermally, what is remarkable about Graphene ?

    (h) Is nano gold yellow in colour ? Justify.

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GN-221

V Semester B.Sc. Examination, December - 2019
(CBCS-Repeaters) (Prior to 2018-19/2016-17 and Onwards)

PHYSICS - VI

Astrophysics, Solid State Physics and Semi-Conductor Physics

Time : 3 Hours

Max. Marks : 70

Instruction : (i) *Answer five questions from each part.*
(ii) *Non-Programmable scientific calculators are allowed.*

PART - A

Answer **any five** of the following questions. Each question carries **eight** marks. **5x8=40**

1. (a) Define apparent and absolute magnitudes of a star. **2+6**
   (b) Obtain an expression for gravitational potential energy of a star.

2. (a) Explain photon diffusion time. **2+6**
   (b) Derive the relation between mass and luminosity of a main sequence star.

3. (a) What is Supernova ? Explain Supernova explosion. **4+4**
   (b) Distinguish between type-I and type-II supernova.

4. What is Compton effect ? Derive an expression for Compton shift. **1+7**

5. Define fermi energy and obtain an expression for it based on free electron theory of metals. **8**

6. (a) What is superconductivity and define critical temperature. **2+6**
   (b) Explain Meissner effect and critical magnetic field.

7. What is Zener diode ? Explain with a circuit diagram the action of Zener diode as a voltage regulator. **1+7**

8. With relevant circuit diagram, explain the characteristics of n-p-n transistor in common emitter mode. **8**

P.T.O.

PART - B

Solve **any five** of the following problems. Each problem carries **four** marks.

<div align="right">**5x4=20**</div>

9. The apparent magnitude of a star Sirius A is -1.44 and that of another star Regulus is $+1.36$ on the magnitude scale of stars. Calculate the relative brightness of the star Sirius A with respect to Regulus.

10. Calculate the radius of the star whose luminosity is 10^4 times the Sun and its surface temperature is 2000 K. Given $T_\odot = 6000$ K and $R_\odot = 7 \times 10^8$ m.

11. Lead is face centered cubic with an atomic radius $r = 1.746$ Å. Find the spacing of (i) (200) plane (ii) (220) plane and (iii) (111) plane.

12. Monochromatic X-rays of wavelength 1.5 Å are incident on a crystal face having an interplanar spacing of 1.6 Å. Find the various orders in which Bragg's reflections take place.

13. A current of 50 A is established in a copper slab of 0.5×10^{-2} m thick and 0.2×10^{-2} m wide. The slab is placed in a magnetic field of 1.5 T. The magnetic field is perpendicular to the plane of the slab and to the current. The free electron concentration in copper is 8.48×10^{28} electron/m³. Calculate the magnitude of Hall voltage.

14. Mobilities of electrons and holes in a sample of intrinsic germanium at room temperature are 0.54 m²/V-s and 0.18 m²/V-s respectively. Calculate the conductivity of germanium. Assume the densities of holes and electrons each are equal to 3.6×10^{19} m⁻³.

15. Calculate the values of β_{dc}, I_C and I_E for a transistor that has $\alpha_{dc} = 0.98$ and $I_B = 100$ μA.

16. The transistor is connected as a C-E amplifier and the h parameters are given below. If $R_L = R_S = 1000$ Ω, find the current gain, input impedance and voltage gain.

   Given $h_{ie} = 1100$ Ω, $h_{fe} = 50$, $h_{oe} = 25$ μs , and $h_{re} = 2.5 \times 10^{-4}$

PART - C

Answer **any five** of the following questions. Each question carries **two** marks.   **5x2=10**

17. (a) Is the brightness of a star is a good indicator of its distance ? Why ?

   (b) Does the luminosity of a star depend on its mass ? Explain.

   (c) Is cooling system required for an X-ray tube ? Justify.

   (d) Does the ratio of thermal conductivity to the electrical conductivity of a metal depend only on temperature ? Justify.

   (e) Hall coefficient is negative for metals and positive for P-type semiconductors. Why ?

   (f) The conductivity of an intrinsic semiconductor is very low. Why ?

   (g) Does the width of the depletion region of a p-n junction depend on the doping concentration ? If yes how ?

   (h) Can emitter and collector regions of a transistor be interchanged ? Justify.

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