Full Set

NS – 287

V Semester B.Sc. Examination, November/December 2016
(2013-14 and Onwards) (CBCS-Fresh/NS- Repeaters)
PHYSICS – V
Quantum Statistical Physics, Quantum Mechanics – I and II

Time : 3 Hours | Max. Marks : 70

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

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks : **(5×8=40)**

1. Derive Bose-Einstein distribution law for bosons. **8**

2. What are fermions ? Derive an expression for the probability distribution of particles governed by Fermi-Dirac statistics. **8**

3. Explain briefly the failure of classical theory in the explanation of :
   i) Stability of an atom.
   ii) Blackbody radiation. **(4+4)**

4. a) Explain phase velocity and group velocity for a matter wave.
   b) Establish a relation between the particle velocity and group velocity of a non relativistic particle. **(3+5)**

5. a) With a neat diagram, describe gamma-ray microscope experiment to illustrate the Heisenberg's uncertainty principle.
   b) Show that electrons cannot remain inside a nucleus using uncertainty principle. **(6+2)**

6. a) Mention any two conditions that a wave function must satisfy.
   b) Arrive at Schrödinger's time independent equation for a free particle in one dimension. Write the equation for three dimensions. **(2+6)**

P.T.O.

7. Set up Schrödinger equation for a particle in a one dimensional box and solve it to obtain eigen values of energy. Also represent the first three wave functions graphically. **8**

8. Develop the Schrödinger's equation for a linear harmonic oscillator. Mention the energy eigen value expression. **8**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks : **(5×4=20)**

Use $h = 6.63 \times 10^{-34}$ JS, $m_e = 9.1 \times 10^{-31}$ kg and $e = 1.6 \times 10^{-19}$ C wherever necessary.

9. A system of 5 particles are arranged in two compartments. The first compartment is divided into 6 cells and the second into 5 cells. The cells are of equal size. Calculate the number of microstates in the macrostate (2, 3), if the particles obey Fermi-Dirac statistics.

10. A gas has two particles A and B. Show with the help of diagrams how these two particles can be arranged in three different quantum states 1, 2, 3 using Bose-Einstein statistics.

11. The Fermi energy for lithium is 4.72 eV at T = 0K. Calculate the number of conduction electrons per unit volume in lithium.

12. Calculate the frequency and energy in eV of a photon of wavelength 400 nm.

13. Calculate the deBroglie wavelength of neutron of energy 28.8 eV. Given $m_n = 1.67 \times 10^{-27}$ kg, $h = 6.63 \times 10^{-34}$ Js.

14. A microscope using photons is employed to locate an electron in an atom to within a distance of 0.1 Å. Calculate the uncertainty in the momentum of the electron located.

15. An electron is trapped inside a box of 1 nm. Calculate the first three eigen values in eV.

16. The energy of a linear harmonic oscillator in its third excited state is 0.1 eV. Calculate the frequency and zero point energy.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks : **(5×2=10)**

17. a) Can an electron have zero energy at T = 0K ? Explain.

    b) Does Fermi energy depends on temperature ? Explain.

    c) An electron and proton are possessing same amount of kinetic energy. Which of the two have greater deBroglie wavelength ? Justify.

    d) We do not experience the existence of matter waves in our day-to-day life. Why ?

    e) Can matter waves move faster than light ? Explain

    f) Why do we normalise a wave function ? Explain.

    g) Distinguish between a particle in a box and a free particle.

    h) Can the quantum number n be zero for a particle in a one dimensional box ? Justify.

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NS – 288

V Semester B.Sc. Examination, November/December 2016
(CBCS/NS, 2013-2014 and Onwards) (F & R)
PHYSICS – VI
Astrophysics, Solid State Physics and Semi-conductor Physics

Time : 3 Hours Max. Marks : 70

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

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Write a note on Yerke's luminosity classification of stars.
   b) Obtain an expression for core pressure of a star on the basis of Linear density model. **(3+5)**

2. a) What is Chandrashekar's mass limit ?
   b) Write a note on H – R diagram, White dwarfs and black holes. **(2+6)**

3. a) What are X – rays ?
   b) State and explain Moseley's law, Mention its applications. **(2+6)**

4. a) State Wiedemann – Franz law.
   b) Derive an expression for electrical conductivity of a metal based on free electron theory. **(2+6)**

5. a) What is Hall effect in metals ?
   b) Explain any three experimental facts about superconductivity. **(2+6)**

6. Obtain an expression for electron concentration in conduction band of Intrinsic semiconductor. **8**

7. a) Distinguish between Conductors, Semiconductors and Insulators on the basis of band theory of solids.
   b) Write a note on LED and Solar cell. **(3+5)**

P.T.O.

8. a) Explain h-parameters with the help of two port Linear network.

   b) Derive an expression for current gain in a CE amplifier in terms of h-parameters. **(4+4)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. The apparent magnitudes of the stars Sirius and the Regulus are – 1.44 and + 1.36 respectively on magnitude scale of stars. Calculate the relative brightness of the star Sirius with respect to Regulus.

10. As per linear density model of a star, calculate gravitational potential energy of a star. Given $R = 7 \times 10^8$ m, $M = 3 \times 10^{30}$ Kg and $G = 6.673 \times 10^{-11}$ $Nm^2 Kg^{-2}$.

11. Calculate the radius of a neutron star whose mass is $2 M_\odot$.

12. In a crystal, a plane cuts intercepts of 3a, 2b and 6c along the three crystallographic axes. Determine the Miller Indices of the plane.

13. Calculate the fermi energy of Lithium. Given density of Lithium is 534 Kg m^{-3} and atomic weight is 6.931 amu (Given 1 amu = 1.667×10^{-27} Kg).

14. Monochromatic X – rays of wavelength 0.15 $\mathring{A}$ undergo Compton effect from a carbon block. Calculate the wavelength of scattered rays through 45°.

15. Mobilities of electrons and holes in a sample of intrinsic germanium at 300 K are 0.36 $m^2 v^{-1} s^{-1}$ and 0.17 $m^2 v^{-1} s^{-1}$ respectively. If the resistivity of the specimen is 2.12 Ωm. Calculate the carrier concentration in intrinsic semiconductor.

16. A certain regulator has a no-load output voltage of 20v and has a full-load output of 19V. What is the load regulation expressed as a percentage ?

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) Is there any mass limit for black holes ? Explain.

b) How do white dwarfs attain stability ? Explain.

c) Is there any unmodified line in Compton scattering ? Explain.

d) Hall coefficient is negative for metals. Why ?

e) Does characteristic spectrum of X – rays depend on the applied voltage ? Explain.

f) An intrinsic semiconductor behaves like a perfect insulator at 0K. Explain.

g) Are there any holes in n – type semiconductor ? Explain.

h) Why is β more than α of a transistor.