11521

Reg. No. | | | | | | | | |

V Semester B.Sc. (CBCS) Degree Examination, March/April - 2022

PHYSICS

Statistical Physics, Quantum mechanics - I

Atmospheric Physics & Nano Materials

(CBCS Scheme Freshers and Repeaters 2018-19 & Onwards)

Paper : V

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

1. Answer any **Five** questions from each part.
2. Use Non - programmable scientific calculators are permitted.

PART - A

Answer any **five** questions. Each question carries Eight marks. **(5×8=40)**

1. a. What are fermions and bosons?

b. Derive an expression for the distribution function of particles obeying Fermi - Dirac statistics. **(2+6)**

2. a. What is Phase Space?

b. Distinguish between Maxwell - Boltzmann statistics, Bose - Einstein statistics and Fermi - Dirac statistics. **(2+6)**

3. Discuss briefly the failure of classical mechanics to explain :

a. Atomic spectra.

b. Black Body radiation. **(4+4)**

4. a. What are matter waves? Mention any two of its characteristics.

b. Deduce an expression for the de-Broglie wavelength and express it in terms of energy and temperature. **(3+5)**

5. a. State and explain Heisenberg's uncertainty principle.

b. Describe gamma - ray microscope experiment to illustrate the uncertainty principle. **(3+5)**

6. a. What is meant by Hydrostatic balance?

b. Derive Beer's law for the absorption of solar radiation by the earth's atmosphere. **(2+6)**

7. a. What are fixed gases and variable gases of the earth's atmosphere?

b. Derive an expression for variation of atmospheric pressure with altitude and give its graphical representation. **(2+6)**

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8. a. Mention the methods of synthesis of nano - materials.
   b. What are zero, one and two dimensional nano systems? Give one example each.(2+6)

PART - B

Answer any **five** questions. Each question carries **four** marks. (5×4=20)

9. A system contains 2 particles A & B and there are three quantum states or cells. With the help of a diagram show the number of arrangements according to
   i. Maxwell - Boltzmann.
   ii. Bose - Einstein statistics.
10. Calculate the Fermi energy of Lithium at T = 0K. Given, the number of conduction electrons per unit volume in Lithium is 2.06×10^{27} m^{-3}. Given h = 6.625×10^{-34} Js, me = 9.1×10^{-31} kg.
11. Calculate the maximum velocity of photoelectrons, when ultraviolet radiation of 260nm is incident on a metal whose threshold wavelength is 380nm. Given $h = 6.625\times10^{-34} Js$, $m_e = 9.1\times10^{-31} kg$, $c = 3\times10^{8} ms^{-1}$.
12. An electron has a de-Broglie wavelength of 1 Å. Calculate the group velocity and phase velocity. Given $h = 6.625\times10^{-34} Js$ $m_e = 9.1\times10^{-31} kg$.
13. In Davisson Germer experiment, electrons accelerated through a potential difference of 54V showed a maximum reflection at 50° (first order). Calculate the wavelength of the electrons. Given d = 2.15 Å.
14. Calculate the pressure gradient force per unit mass between two isobars of pressure 103.9kPa and 100.3 kPa which are separated by 79 km from each other. Given density of air = 1.2 kgm^{-3}.
15. A mass weighing 0.9 kg is thrown from a point 30°N towards north (in the northern hemisphere) with a velocity of 0.6kms^{-1}. Find the magnitude and direction of the Coriolis force acting on the mass. Given, $\omega=7.27\times10^{-5}$rad-s^{-1}.
16. Calculate the total mass of the earth's atmosphere. Given the pressure at sea level is equal to 1.013×10^{5}Pa, Radius of the earth = 6400 km and g = 9.8 ms^{-2}.

PART - C

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

17. a. Why do bosons and Fermions have different distribution function?
    b. He^4 shows Bose - Einstein condensation, while He^3 does not. Explain.
    c. Can we use M-B statistics to explain the properties of photon gas? Explain.
    d. Are de-Broglie waves observed in case of macroscopic objects? Explain.
    e. Is water vapor a green house gas? Explain.
    f. Can optical microscope be used to observe nano - particles? Explain.
    g. Graphene is the strongest material. Justify.
    h. The properties of materials are different at nano level. Why?

11522

Reg. No.

V Semester B.Sc. Degree Examination, March/April - 2022

PHYSICS

Astrophysics, Solid State Physics and Semiconductor Physics

(CBCS-Freshers+Repeaters 2018-19 & Onwards Scheme)

Paper : VI

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

1. Answer any **five** questions from each part.
2. Non - programmable scientific calculators is allowed.

PART - A

Answer any **five** questions. Each question carries **Eight** marks. **(5×8=40)**

1. Obtain the expression for core pressure of a star on the basis of Linear density model. **(8)**

2. Obtain an expression for gravitational potential energy of a star on the basis of Linear density model. **(8)**

3. a) What is Chandrasekhar's mass limit?

b) Obtain an expression for core temperature of a star. **(2+6)**

4. Derive the expression for electrical conductivity of a metal based on free electron theory. Hence arrive at ohms law. **(8)**

5. a) What is Hall effect? Arrive at the expression for Hall co-efficient.

b) Distinguish between continuous and characteristic X-ray spectra. **(4+4)**

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

7. a) What is a solar cell?

b) Obtain an expression for the concentration of free electrons in an intrinsic semiconductor. **(1+7)**

8. a) What are hybrid parameters?

b) Using hybrid equivalent circuit, derive the expression for current gain and voltage gain of CE amplifier. **(2+6)**

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PART - B

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

9. The apparent and absolute magnitude of a star are +0.87 and -0.63 respectively. Calculate its distance from the earth.

10. If the luminosity and surface temperature of a star are 26 L_{sun} and 1.12×10^{4} K respectively, calculate its radius. Given $L_{sun} = 4\times10^{26}$W, $R_{sun} = 7\times10^{8}$m. T_{sun}=6000K.

11. Find the interplanar spacing for the lattice planes of Miller indices (3 2 1), (2 1 0) for cubic lattice with a = 5.26 Å.

12. In an experiment on Compton scattering X - rays of wavelength 1.5×10^{-10}m are used. Calculate the wavelength of X-rays scattered at an angle 60°. Given h = 6.625×10^{-34}Js, m_o=9.1×10^{-31}kg and c = 3×10^{8}ms^{-1}.

13. Assuming one free electron per atom, estimate the Fermi energy for copper. Given the density of copper = 8.95×10^{3} kg m^{-3} and atomic mass = 0.0635 kg mol^{-1}.

14. Calculate the conductivity of silicon material if mobility of electrons and holes are $0.32m^2V^{-1}s^{-1}$ and $0.18m^2V^{-1}s^{-1}$ respectively and intrinsic carrier concentration n_i is $18\times10^{22}m^{-3}$. Given e=1.6×10^{-19}C.

15. A 24 V - 600 mW Zener diode is to be used for providing 24V stabilized supply to a variable load. If the input voltage is 32V calculate the value of series resistance.

16. Calculate the values of β_{dc}, I_C and I_E for transistor that has $\alpha_{dc} = 0.96$ and $I_B = 120\mu A$.

PART - C

Answer any **Five** questions. Each question carries **Two** marks. **(5×2=10)**

17. a) Is the brightness of star a good indicator of its distance? Explain.
    b) Can Black holes be seen? Explain.
    c) Do white dwarfs attain stability? Explain.
    d) Is an unit cell of fcc structure a primitive cell? Explain.
    e) Why ordinary light cannot be used for crystal diffraction? Explain.
    f) Is p-type semiconductor electrically neutral? Explain.
    g) Can emitter and collector regions of transistor be inter changed? Justify.
    h) Superconductor is an ideal diamagnetic material. Justify.