61502

V Semester B.Sc. Examination, April/May 2023
(CBCS Scheme) (2018-19 Onwards)
PHYSICS – VI
Astrophysics, Solid State Physics and Semiconductor Physics

Time : 3 Hours Max. Marks : 70

Instructions : 1) *Answer* ***any five*** *questions from* ***each*** *Part.*
2) *Non-Programmable* ***scientific*** *calculator are* ***allowed***.

PART – A

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

1. a) Define apparent magnitude and absolute magnitude of a star.
   b) Derive an expression for the distance of a star in terms of its apparent and absolute magnitude. **(2+6)**

2. a) Write a note on white dwarfs and black holes.
   b) What is Chandrashekar's Mass Limit ? Explain its significance. **(4+4)**

3. What is Compton effect ? Derive an expression for Compton shift. **8**

4. a) Define Fermi Level and Fermi Energy.
   b) Obtain an expression for Fermi energy of an electron in metals at absolute zero based on free electron theory of metals. **(2+6)**

5. a) What is superconductivity ? Mention four applications of superconductivity.
   b) What is Meissner effect ? Explain. **(4+4)**

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

7. Explain the working of
   a) LED
   b) Solar cell. **(4+4)**

P.T.O.

8. a) Explain the input and output characteristics of a n-p-n transistor connected in common-emitter configuration.

   b) What is meant by

      a) Operating point

      b) Dc load line ?

(6+2)

PART – B

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

9. Assuming linear density model of a star, calculate the gravitational potential energy of a star.

   Given $G = 6.673 \times 10^{-11}\ Nm^2\ kg^{-2}$

   $M = 3 \times 10^{30}$ kg

   $R = 7 \times 10^8$ m

10. Calculate the internal pressure of the sun at a distance 4×10^8 m from its centre. The core pressure of the sun is $1.075 \times 10^{15}\ Nm^{-2}$. Given $R = 6.9599 \times 10^8$ m.

11. In the constellation Orion, there is bright reddish star called Betelgeuse. Its luminosity is 10,000 times that of the sun, and its surface temperature about 3000 k. How much larger is the radius of Betelgeuse compared to that of the sun ? Take surface temperature of the sun to be 5800 k.

12. Calculate the interplanar spacing for (133) plane in a crystal lattice whose lattice constant is 4.6 Å.

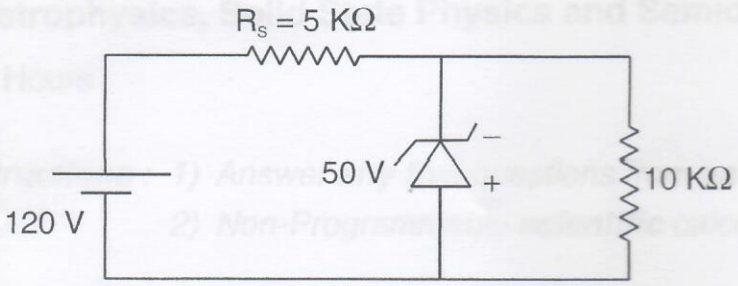
13. Calculate the Hall voltage developed in a silicon crystal of thickness 2 mm when a magnetic field of 2T is applied.
    Given : current density is 500 A/m^2 and concentration of electrons is $8 \times 10^{22}/m^3$.

14. The intrinsic carrier density at room temperature in Ge is $2.37 \times 10^{19}\ m^{-3}$. If the electron and hole mobilities are 0.38 m^2/volt. sec. and 0.18 m^2/volt. sec. respectively. Calculate the resistivity.

15. For the circuit shown below find

    i) Voltage drop across R_s

    ii) Load current.



16. A transistor used in common-emitter configuration has the following set of h-parameters :

    h_{ie} = 1 kΩ

    h_{fe} = 100

    $h_{re} = 5 \times 10^{-4}$

    $h_{oe} = 2 \times 10^{-5}$S

    If R_s = 2 kΩ and R_L = 5 kΩ, calculate

    i) Input impedance and

    ii) Current gain.

PART – C

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

17. a) Two stars A and B have a parallax of 0.76" and 0.56". Which is most distant ? Why ?

    b) Is the surface temperature of a star related to color of a star ? Explain.

    c) Do all the neutron stars become pulsars ? Explain.

    d) Can ordinary light be used for crystal diffraction ? Explain.

    e) Hall coefficient is negative for metals. Justify.

    f) A superconductor is perfectly diamagnetic. Explain.

    g) Can a Zener diode be used as a voltage regulator ? Explain.

    h) Is β more than α ? Explain.