UN – 171

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V Semester B.Sc. Examination, November/December 2015
(New Scheme) (2013-14 & Onwards)
PHYSICS – VI
Astrophysics, Solid State Physics and Semiconductor 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. Obtain an expression for the gravitational potential energy of a star based on linear density model. **8**

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. Obtain an expression for the electrical conductivity of metals based on free electron theory. Hence establish Ohm's law. **8**

5. a) What is Hall effect ? Derive an expression for Hall coefficient in metals.
   b) Write a note on type I and type II semiconductors. **(4+4)**

6. Derive an expression for hole concentration in an intrinsic semiconductor. **8**

7. a) Describe a zener diode voltage regulator and explain load regulation.
   b) Explain the principle and working of a solar cell. **(4+4)**

8. a) Explain the input and output characteristics of a npn transistor connected in common-emitter configuration.
   b) What is meant by dc load line ? Explain. **(6+2)**

P.T.O.

PART – B

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

9. The luminosity of the star Achernar is 5250 $L_\odot$. If it is 144 light years away from the earth, calculate its brightness.

10. If the apparent and absolute magnitude of a star are + 0.87 and – 0.63 respectively. Calculate its distance from the earth.

11. Calculate the average pressure of the sun. Given : $R_\odot = 6.9599 \times 10^8 m$, $M_\odot = 1.989 \times 10^{30} kg$ and $G = 6.673 \times 10^{-11} Nm^2 kg^{-2}$.

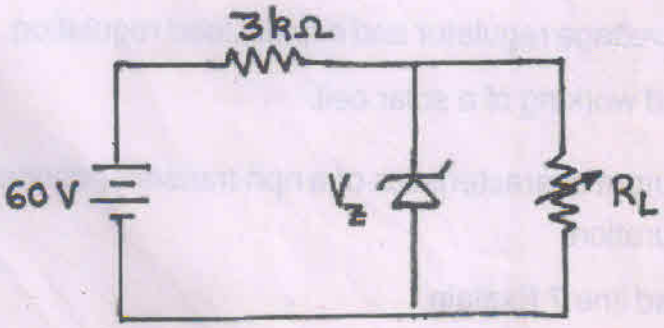
12. Calculate the glancing angle on the plane (110) of a cube rock salt (a = 2.81 Å) corresponding to second order diffraction maximum for X-rays of wavelength 0.71 Å.

13. Calculate the conductivity of pure germanium if the carrier concentration is $2.1 \times 10^{19} m^{-3}$. The mobility of holes and electrons are 0.4 m^2/v-s and 0.2 m^2/v-s respectively.

14. Calculate the Fermi energy of sodium assuming that the metal has 1 free electron per atom.

    Given h = 6.625×10^{-34} J-s, m = 9.1×10^{-31} kg and number of free electrons per unit volume = 2.54×10^{28}.

15. In a zener diode regulator shown, find the current through the diode when load resistance is
    a) 30 kΩ and
    b) 3 kΩ . Given : V_z = 30 V.



16. A transistor used in common-emitter configuration has the following set of parameters : $h_{ie} = 1.1k\Omega$, $h_{re} = 2.5 \times 10^{-4}$, $h_{fe} = 50$ and $h_{oe} = 25 \times 10^{-6}$ s. Calculate input impedance and output impedance if $R_S = R_L = 1\ k\Omega$.

PART – C

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

a) Is brightness of a star a good indicator of its distance ? Explain.

b) A massive star is more luminous than a less massive star. Why ?

c) Can a black hole be seen ? Explain.

d) Does electrical conductivity of a semiconductor depend on its temperature ? Explain.

e) Is Bloch theorem applicable to constant potential ? Explain.

f) In what direction does the Fermi level move in a semiconductor doped with donor impurity as the temperature increases ?

g) Is solar cell a photovoltaic cell ? Explain.

h) Why are hybrid parameters called so ?