SS – 322

V Semester B.Sc. Examination, November/December 2018
(CBCS) (Fresh) (2018 – 19 and Onwards)
PHYSICS – VI
Astrophysics, Solid State Physics and Semiconductor Physics

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **five** questions from Part – **A**, **5** questions from Part – **B** and **5** questions from Part – **C**.*

PART – A

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

1. a) Define apparent magnitude and absolute magnitude of a star. Hence obtain the distance modulus expression.

   b) Obtain an expression for core temperature of a star. **(4+4)**

2. 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)**

3. a) State and explain Moseley's law. Mention any two applications of Moseley's law.

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

4. a) State Wiedmann-Franz law.

   b) Derive an expression for electrical conductivity of a metal based on free electron theory. **(2+6)**

5. a) Define Hall Voltage. Derive an expression for Hall coefficient in the case of metals.

   b) What is meant by critical magnetic field in superconductivity ? Explain its temperature dependence. **(5+3)**

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6. a) Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids.

   b) Describe a Zener diode as a voltage regulator and explain its load regulation. (4+4)

7. Obtain an expression for electron concentration in conduction band of an intrinsic semiconductor. 8

8. a) With neat diagram explain the working of an NPN transistor in CE-mode, as an amplifier.

   b) Mention the h-parameters of the transistor. (6+2)

PART – B

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

$G = 6.67 \times 10^{-11}\ Nm^2Kg^{-2}$; $M_\odot = 2 \times 10^{30}$ Kg; $R_\odot = 7 \times 10^8$ m; $T_\odot = 6000K$; $C = 3 \times 10^8\ ms^{-1}$.

9. Suppose the sun shrank from its present size so that its radius is halved. What would be the change in its gravitational potential energy ?

   Given : The mass of the sun ($M_\odot$);

   Radius of the sun ($R_\odot$).

10. The luminosity of a star is 10^4 times that of sun and its surface temperature is 2000 K. How much larger is the radius of the star compared to that of the sun ?

    Given : Surface temperature of the sun ($T_\odot$);

    Solar radius ($R_\odot$).

    Calculate the radius of the star.

11. Calculate the Schwarzschild's radius of a black hole of mass $20 \times 10^6\ M_\odot$.

    Given : Gravitational constant (G);

    Mass of the sun ($M_\odot$); Velocity of light (C).

12. Find the Miller indices of a set of parallel planes which make intercepts in the ratio 3a:4b, parallel to Z-axis. Also calculate the interplanar spacing of the planes taking the lattice to be cubic with $a = 2\,\text{Å}$.

13. X-rays of wavelength $0.3\,\text{Å}$ undergo a $60°$ compton scattering. Find the wavelength of the photon after scattering.

14. Assuming one free electron per atom, estimate the Fermi energy for copper.

Given : The density of copper $= 8.95 \times 10^3$ Kg/m^3.

Atomic mass = 0.0635 Kg/mole.

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

16. Calculate I_C and I_E for a transistor that has $\alpha_{dc} = 0.98$ and $I_B = 100\,\mu A$. Determine the value of β_{dc}.

PART – C

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

a. The brightness of a star is not a good indicator of its distance. Why ?

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. Why ordinary light can not be used for crystal diffraction ? Explain.

f. Are there holes in the n-type semiconductor ? Explain.

g. Are the energy levels completely filled below Fermi-level at absolute zero ? Explain.

h. Why are hybrid parameters called so ?