No. of Printed Pages : **3**

102296

GN-217

V Semester B.Sc.Examination, December - 2019
(CBCS) (Fresh+Repeaters) (2018-19 and Onwards)

PHYSICS - VI

Astrophysics, Solid State Physics and Semiconductor Physics

Time : 3 Hours Max. Marks : 70

Instructions : (*i*) *Answer* ***any five*** *questions from each Part.*
(*ii*) *Non-programmable scientific calculators are allowed.*

PART - A

Answer **any five** questions. Each question carries **8** marks. **5x8=40**

1. Define gravitational potential energy of a star. Using linear density model derive an expression for gravitational potential energy of a star. **8**

2. (a) Write any four General characteristics of Main Sequence Stars. **4+4**
(b) State and explain Virial theorem.

3. (a) What are Miller Indices ? Explain the steps followed in assigning Miller indices for a set of planes with an example. **4+4**
(b) With a neat diagram, derive Bragg's law of X-ray diffraction.

4. (a) Write assumptions of classical free electron theory of metals. **4+4**
(b) Based on free electron theory of metals, obtain an expression for average kinetic energy of a free electron at absolute zero.

5. (a) What is Hall effect in metals ? Arrive at expression for Hall Coefficient. **4+4**
(b) Distinguish between Type I and Type II Superconductors.

6. Obtain an expression for Concentration of holes in an intrinsic semiconductor. **8**

7. (a) Explain the working of a pn-diode in reverse biased condition. **4+4**
(b) Distinguish between ordinary diode and a zener diode.

8. What are hybrid parameters ? Write expressions for hybrid parameters. With the help of a hybrid equivalent circuit of a CE-transistor amplifier derive expressions for (i) Voltage gain (ii) Input impedance. **6+2=8**

P.T.O.

PART - B

Solve **any five** problems. Each problem carries **four** marks. **5x4=20**

9. If the luminosity and surface temperature of a star are 25 L⊙ and 1.12×10^4 K respectively, Calculate its radius. Given that Stefan-Boltzmann constant $(\sigma) = 6 \times 10^{-8}$ Wm^2K^{-4} and luminosity of Sun (L⊙) to be 4×10^{26} W. **4**

10. A Star whose apparent magnitude is observed to be 7 has a parallax of 0.015″. Calculate its absolute magnitude. Also compare the luminosity of the given star with that of the Sun. Given that absolute magnitude of Sun (M⊙) = 5. **4**

11. Calculate the core pressure of the Sun. Given $G = 6.673 \times 10^{-11}$ Nm^2/kg^2 and $R_\odot = 6.96 \times 10^8$ m, $M_\odot = 2 \times 10^{30}$ kg. **4**

12. X-rays with $\lambda = 1$ Å are scattered from a carbon block. The scattered radiation is viewed at 90° to the incident beam. **4**

(i) What is the Compton Shift ?

(ii) How much kinetic energy is imparted to the recoiling electron ?

13. Following are the Miller indices for four different sets of parallel planes for a cubic crystal. **4**

(i) (100) (ii) (010) (iii) (111) (iv) (011)

Represent or draw the corresponding lattice planes on a cubic structure.

14. Calculate the Fermi energy and Fermi velocity for Lithium. The density and atomic weight of Lithium are 534 kg/m^3 and 6.931 amu respectively. **4**

15. A 25 V, 550 mW zener diode is to be used for providing a 25 V stabilized supply to a variable load. If the input voltage is 35 V. Calculate the value of Series Resistance (R_s). **4**

16. For a silicon transistor connected in CE-Configuration, find I_B, I_C and V_{CE}. Given that $\beta = 150$, $V_{BE} = 0.7$ V, $V_{CC} = 15$ V and $V_{BB} = 9$ V, $R_C = 5$ kΩ and $R_B = 1$ MΩ. **4**

PART - C

Answer **any five** questions. Each question carries **2** marks. **5x2=10**

17. (a) Which two forces must be balanced to keep a white dwarf stable ?

(b) Star A has a magnitude of $+1$ and Star B has a magnitude of -1, which star is brighter ? Explain.

(c) Is an unit cell of fcc structure, a primitive cell ? Explain.

(d) In a semiconductor what is the effect of doping on the position of the Fermi level ?

(e) Can we apply classical model to study Hall effect in semiconductors ? Explain.

(f) Is solar cell a photovoltaic cell ? Explain.

(g) What is the basic biasing condition for the proper functioning of a transistor as an amplifier ?

(h) Why the collector region in a transistor is made wider than the emitter and base regions ?

- o O o -