



**GN-217**

100832

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  $25 L_{\odot}$  and  $1.12 \times 10^4 \text{ K}$  respectively, Calculate its radius. Given that Stefan-Boltzmann constant ( $\sigma$ ) =  $6 \times 10^{-8} \text{ Wm}^2\text{K}^{-4}$  and luminosity of Sun ( $L_{\odot}$ ) to be  $4 \times 10^{26} \text{ W}$ . 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 ( $M_{\odot}$ ) = 5. 4
11. Calculate the core pressure of the Sun. Given  $G = 6.673 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$  and  $R_{\odot} = 6.96 \times 10^8 \text{ m}$ ,  $M_{\odot} = 2 \times 10^{30} \text{ kg}$ . 4
12. X-rays with  $\lambda = 1 \text{ \AA}$  are scattered from a carbon block. The scattered radiation is viewed at  $90^\circ$  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  $534 \text{ kg/m}^3$  and  $6.931 \text{ amu}$  respectively. 4
15. A  $25 \text{ V}$ ,  $550 \text{ mW}$  zener diode is to be used for providing a  $25 \text{ V}$  stabilized supply to a variable load. If the input voltage is  $35 \text{ V}$ . 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  $\beta = 150$ ,  $V_{BE} = 0.7 \text{ V}$ ,  $V_{CC} = 15 \text{ V}$  and  $V_{BB} = 9 \text{ V}$ ,  $R_C = 5 \text{ k}\Omega$  and  $R_B = 1 \text{ M}\Omega$ . 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 ?

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