SN – 238

V Semester B.Sc. Examination, November/December 2014
(New Scheme) (2013-14 & Onwards)
PHYSICS – VI
Astrophysics, Solid State Physics and Semiconductor Physics

Time : 3 Hours

Max. Marks : 70

Instruction: *Answer **5** 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) State and explain Virial theorem.
   b) Derive mass-luminosity relation of a star. **(3+5)**
2. a) What is Supernova ? Explain Supernova explosion.
   b) Distinguish between type – I and type – II supernova. **(4+4)**
3. a) State and explain Moseley's law. Mention any two importances of Moseley's law.
   b) Distinguish between the continuous and characteristic X-ray spectra. **(4+4)**
4. a) Define Hall voltage. Derive an expression for Hall field in the case of metals.
   b) What is meant by critical magnetic field in super conductivity ? Explain. **(5+3)**
5. a) What is Kronig-Penney modes ? Explain.
   b) Derive an expression for electrical conductivity on the basis of free electron theory. State Wiedemann-Franz law in the case of metals. **(2+6)**
6. a) What are intrinsic and extrinsic semiconductors ?
   b) Obtain an expression for electron concentration in an intrinsic semiconductor. **(2+6)**
7. a) Explain the variation of width of depletion with applied forward and reverse voltages.
   b) What is static resistance of a p-n junction diode ? Explain.
8. a) Distinguish between the saturation and cut-off regions of a transistor.
   b) Explain the working of an N-P-N transistor in CE mode as an amplifier.

P.T.O.

PART – B

$N_A = 6.06 \times 10^{26}\ kg - mole$ $e = 1.6 \times 10^{-19} C$ $1\ amu = 1.66 \times 10^{-27}\ kg$
$h = 6.63 \times 10^{-34}\ JS$ $m_e = 9.1 \times 10^{-31}\ kg$
$k = 1.38 \times 10^{-23}\ JK^{-1}$ $C = 3 \times 10^8\ ms^{-1}$

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

9. Assuming that the dimmest star visible to the naked eye has a magnitude of about –5 compare its brightness with that of a brightest star whose magnitude is – 4.
10. If the luminosity and surface temperature of the star are 26.1 $L_\odot$ and 10000 K respectively, calculate its Radius, given Stefan-Boltzman's constant $\sigma = 5.67 \times 10^{-8}\ wm^{-2}k^{-4}$ and luminosity of sun 3.9×10^{26} W.
11. Calculate the rotational kinetic energy of a neutron star of mass 2.5 $M_\odot$, radius 1.5 $R_\odot$ and frequency 25 rps. Given : Mass of the sun and radius of the sun are 1.989×10^{30} kg and 6.9599×10^8 m respectively.
12. X-rays of wavelength 0.3Å undergo a 60° compton scattering. Find the wavelength of the photon after scattering.
13. Calculate the Fermi energy and Fermi velocity for lithium, given density to be 534 kgm^{-3} and atomic weight to be 6.931 amu.
14. Find the mobility of electrons in copper assuming that each atom contributes one free electron for conduction. Resistivity of copper is 1.7×10^{-8} ohm – m. Atomic weight of copper is $63.54 \times 10^3\ kg\ mol^{-1}$ and its density is 8960 kgm^{-3}.
15. A 24 V, 600 mw Zener diode is to be used for providing a 24 V stabilized supply to a variable load. If the input voltage is 32 V, calculate the value of series resistance.
16. The following quantities are measured in CE amplifier circuit with output A.C short circuited : $I_b = 10\ \mu A$, $I_c = 1 mA$, $V_{be} = 10$ mV. Calculate h_{fe} and h_{ie}.

PART – C

17. Answer **any five** of the following. **Each** question carries **two** marks. (5×2)
    a) The brightness of a star is not a good indicator of its distance. Why ?
    b) The sun is a mediocre member of the main sequence stars. Justify.
    c) A black hole cannot be seen. Explain why ?
    d) Can ordinary light be used for crystal diffraction ? Explain.
    e) Are ionic crystals good electrical conductors ? Explain.
    f) Are the energy levels completely filled below the Fermi energy level at Absolute zero ? Explain.
    g) Are there holes in the n-type semiconductor ? Explain.
    h) Can the emitter and collector regions of a transistor be interchanged ? Explain.