2015

ELECTRONICS

[Honours]

PAPER – II (New)

Full Marks : 100

Time : 4 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

[NEW SYLLABUS]

GROUP–A

Answer any **two** questions : 15 ×2

1. (*a*) Explain photoelectric effect.

   (*b*) Explain with neat diagrams Davisson-Germer experiment and explain how it verify de' Broglie equation.

(*c*) State Heisenberg's uncertainty principle. 4 + 10 + 1

2. (*a*) Assuming particle in a one dimensional infinitely deep potential well find the energy levels and wave function. Also plot the eigen-functions in the well corresponding to first three energy states.

(*b*) Show that components of the angular momentum operator do not commute. (7 + 3) + 5

3. (*a*) What is Planck's hypothesis ?

(*b*) Deduce Planck's relation to explain the energy spectrum in a black body. 3 + 12

GROUP–B

Answer any **five** questions : 8 × 5

4. (*a*) Compare the basic postulates of the Maxwell-Boltzmann, Bose-Einstein statistics and Fermi-Dirac statistics.

(*b*) Find the Fermi energy for a metal at T = OK. 4 + 4

5. State second law of Thermodynamics in terms of entropy. Discuss the statement "The entropy of a substance is a measure of the degree of disorder prevailing among the molecules. 4 + 4

6. (*a*) Describe in details Joule-Thomson effect.

   (*b*) Prove that for a perfect gas Joule-Thomson coefficient is zero. 5 + 3

7. Assuming an one dimensional harmonic oscillator find the energy level expression. 8

8. (*a*) Explain Orbital magnetic moment and spin magnetic moment in a solid.

   (*b*) What is Hunde's rules ? 6 + 2

9. (*a*) Define Miller indices of a set of planes in a crystal. Using proper formula show that the ratio of the inter planar spacings of (100), (110) and (111) planes is $\sqrt{6} : \sqrt{3} : \sqrt{2}$.

   (*b*) What is Hall effect in solid ? State its importance ? (2 + 3) + (2 + 1)

10. (*a*) What is the physical significance of effective mass of an electron in a homogeneous isotropic crystal ? Show that it is given by

$$m = \hbar^2 / \frac{d^2E}{dK^2}$$

(*b*) Draw the E-K diagrams for free electrons and bound electrons in a solid. (2 + 3) + 3

11. Describe the construction, function and uses of Nicol prism. 8

GROUP–C

Answer any **five** questions : 4 × 5

12. What do you mean by group velocity and phase velocity ? 4

13. What is an ensemble ? Derive an expression for life find of a microstate. 2 + 2

14. Considering an LR circuit find an expression for inductive time constant ? What is the physical significance of time constant ? 3 + 1

(*Continued*)

15. Find *eigenfunction and eigenvalue* of the operator $\left(-i\frac{d}{dx}\right)$ assuming eigenfunction have a period L. 4

16. What is compton shift ? Why compton effect is not prominent in case of visible light ? 3 + 1

17. Using Maxwell's thermodynamic relations, show that the ratio of adiabatic to isobaric volume expansivity is $1/(1-\gamma)$, where the symbol has usual meaning. 4

18. Define and explain the terms microstate and macrostate. 4

19. Discuss how the resistance of an intrinsic semiconductor varies with temperature. 4

[*Internal Assessment* : 10 marks]