Tribhuvan University

Institute of Science and Technology

2074

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Bachelor Level / First Year/ First Semester/ Science
Computer Science and Information Technology (PHY. 113)
(Physics)

Full Marks: 60
Pass Marks: 24
Time: 3 hours.

Candidates are required to give their answers in their own words as for as practicable.
The figures in the margin indicate full marks.

Attempt <u>any two</u> questions: (10×2=20)

1. Explain equilibrium current across the *pn* junction? Use Fermi-Dirac statistics and Maxwell-Boltzmann distribution to show the flow *n* to *p* is equal to the flow from *p* to *n*. How electron current from p to n (that is, associated with minority carries) is not affected by the height of the potential energy barrier? Explain. (10)

2. Describe moment of inertia and torque for a rotating rigid body. Find the expression for rotational kinetic energy and discuss the conditions for conservation. (10)

3. Explain the theory of black body radiation. Why this theory needs quantum mechanical interpretation? How this interpretation became experimentally successful? Explain. (10)

Attempt <u>any eight</u> questions: (5×8=40)

4. Explain Hall effect and discuss the importance of Hall voltage while manufacturing electronic devices. (5)

5. Discuss effective mass of electrons and holes. (5)

6. Describe electrical conductivity of semiconductors. (5)

7. An oscillating block of mass 250 g takes 0.15 sec to move between the endpoints of the motion, which are 40 cm apart. (a) What is the frequency of the motion? (b) What is the amplitude of the motion? (c) What is the force constant of the spring? (5)

8. A current of 50 A is established in a slab of copper 0.5 cm thick and 2 cm wide. The slab is placed in a magnetic field *B* of 1.5 T. The magnetic field is perpendicular to the plane of the slab and to the current. The free electron concentration in copper is $8.4. \times 10^{28}$ electrons/m^3. What will be the magnitude of the Hall voltage across the width of the slab? (5)

9. The uncertainty in the position of a particle is equal to the de Broglie wavelength of the particle. Calculate the uncertainty in the velocity of the particle in terms of the velocity of the de Broglie wave associated with the particle. (5)

10. (a) How many atomic states are there in hydrogen with $n = 3$? (b) How are they distributed among the subshells? Label each state with the appropriate set of quantum numbers n, I, m_l, m_s. (c) Show that the number of states in a shell, that is, states having the same n, is given by $2n^2$. (5)

11. Copper has a face-centered cubic structure with a one-atom basis. The density of copper is 8.96 g/cm^3 and its atomic weight is 63.5 g/mole. What is the length of the unit cube of the structure? (5)