29 NOV 2017

Roll No. _____

B. Tech. (Semester I) End Semester Examination, 2017-18

Subject: PHYSICS – I (Course Code: PHIR 11)

Programme: B. Tech
Maximum Marks: 50
Time Allowed: 3 Hrs
Total no. of pages used: 02

Semester: 1st (All Branches)
No. of Questions to be Attempted: 05
Total no. of Questions: 08

Note:

- Attempt **Five questions** in all, selecting at least **Two questions** from each section.
- **Do not write** anything on the question paper, except your **Roll no**.
- Attempt **each** part of a particular question at the **same place** in your answer sheet.
- Wherever necessary, draw **relevant, neat** and **labelled schematic diagrams**.

Section : A

1. **(a)** Derive the time independent Schrödinger wave equation for a non-relativistic particle moving in the potential energy V(x). Explain the significance of the wavefunction. [7]

   (b) What would be the energy difference between the ground state and first excited state for an electron confined in a 1 nm box? [3]

2. State and write the mathematical expressions for basic laws of electromagnetism. Derive the differential form of Maxwell's equations. [10]

3. **(a)** Derive the planar density expressions for (100) and (111) planes in FCC system in terms of atomic radius "*R*". [5]

   (b) NaCl exhibits FCC structure whose density is 2180 Kg/m^3. The atomic weights of Na and Cl are 23 and 35.5 respectively. Find the lattice constant '*a*' of the NaCl structure. [5]

4. **(a)** On the basis of Band theory of solids, describe following concepts (a) *E- k* diagram, and (b) Brillouin zone. [5]

   (b) Calculate the Hall-coefficient and electron mobility for a semiconductor sample of dimension 1 cm × 5 mm × 1mm. The current through this sample is 5 mA because of a voltage supply of 1.35 V. A Hall voltage 20 mV is observed across the sample in a magnetic field of 0.45 Weber/m^2. [5]

Section : B

5. (a) Describe the experimental setup, theory and applications of Newton's ring experiment. **[6]**

   (b) A Newton's ring setup is illuminated using He-Ne LASER. The diameter of 5th and 25th Newton's rings is 0.3 and 0.8 cm respectively. Calculate the radius of curvature of the plano-convex lens used in the experiment. **[4]**

6. (a) Discuss following processes in LASERs with neat relevant diagram, (i) stimulated absorption, (ii) spontaneous emission (iii) stimulated emission and (iv) population inversion. **[6]**

   (b) Describe the construction and working mechanism of a He-Ne LASER using neat relevant diagrams. **[4]**

7. State the fundamental postulates of the special theory of relativity and derive Lorentz's transformation equations. **[10]**

8. Discuss the process of nuclear fission. Describe the construction and working principle of a Nuclear Fission reactor using suitable schematic diagram. **[10]**

Relevant Physical constants:

$h = 6.626 \times 10^{-34}$ J s,

$c = 2.998 \times 10^{8}$ m/s,

$e = 1.60 \times 10^{-19}$ C,

$m_e = 9.11 \times 10^{-31}$ kg,

Avogadro no.$= 6.022 \times 10^{23}$