BTC – 12

I Semester B.Tech. Examination, Feb./March 2010

ENGINEERING PHYSICS – I

Time : 3 Hours | Max. Marks : 80

Instructions : *1) Answer **all** questions in Part **A**, **6** out of 8 questions in Part **B** and **3** out of 5 questions in Part **C**.*
*2) Part **A** : Questions from **1** to **8** carry **1** mark **each** and **9** to **14** carry **2** marks **each**.*
*3) Part **B** : **Each** question carries **5** marks.*
*4) Part **C** : **Each** question carries **10** marks.*

[Constants : Electron charge e = 1.6×10^{-19} c, Planck's constant h = 6.63×10^{-34} Js Mass of electron m = 9.11×10^{-31} Kg, Velocity of light = c = 3×10^{8} ms^{-1}]

PART – A

1. Write an expression for phase velocity and group velocity.
2. Write the Heisenberg's uncertainty principle in the measurement of energy and time.
3. Define Fermi energy.
4. Give two examples of solid dielectric materials.
5. Define population inversion.
6. Give two examples of super conductors.
7. Write Bragg's law.
8. What are ultrasonic waves?
9. Calculate the deBroglie wavelength associated with an electron subjected to a potential difference of 1.25×10^{3}V.
10. The uncertainty in the position of an electron is 4×10^{-10}m. Calculate the uncertainty in its momentum.
11. Find the drift velocity of free electrons in a copper wire whose cross sectional area is $1 \times 10^{-6} m^2$, when the wire carries a current of 1A. (Given number of electrons/unit volume = n = 8.5×10^{28} electrons/m^3).
12. Show the arrangement for recording of image in holography.
13. Name any four types of crystal systems.
14. What are Maglev vehicles and SQUIDs?

P.T.O.

PART – B

1. Explain the characteristics of matter waves.
2. State Heisenberg's uncertainty principle. Based on this prove that free electrons cannot exist inside the nucleus.
3. Explain the components and construction of He-Ne laser.
4. What are the assumptions of classical free electron theory ?
5. Derive Clausius-Mossotti equation.
6. Explain Type-I and Type-II super conductors.
7. Derive an expression for inter planar spacing in terms of miller indices.
8. What are classical mechanical systems? Explain in brief the scaling of classical mechanical systems with two examples and assumptions involved in it.

PART – C

1. Describe Davisson and Germer experiment and explain how it enabled verification of deBroglie equation.
2. a) Set up time-independent Schrodinger's wave equation for free particle in one dimension.

   b) An electron is bound in one dimensional potential well of width $1 \text{x} 10^{-10}$m, but of infinite wall-height. Find its energy values in the ground state and the first excited state.
3. a) Derive an expression for energy density of radiation in terms of Einstein's coefficients.

   b) A He-Ne laser is emitting a laser beam with an average power of $4.5 \text{ x } 10^{-3}$W. Find the number of photons emitted per second by the laser. The wavelength of emitted radiation is $6328 \text{ x } 10^{-10}$m.
4. Discuss the characteristic features of soft and hard magnetic materials. Also mention one important application of each.
5. a) What is numerical aperture? Obtain an expression for numerical aperture in terms of refractive indices of core and cladding of an optical fiber.

   b) An optical fiber has a core material with refractive index 1.55 and cladding material with refractive index of 1.50. The light is launched into it in air. Calculate the numerical aperture and the acceptance angle.
