

STBSC202 - Engineering Physics

P. Pages : 3

Time : Three Hours



GUG/S/25/16792

Max. Marks : 80

- Notes :
1. All questions carry equal marks.
 2. Assume suitable data wherever necessary.
 3. Illustrate your answers wherever necessary with the help of neat sketches.
 4. All questions are compulsory.
 5. Diagram and chemical equation should be given wherever necessary.
 6. Use of non-programable calculator is permitted.

List of constant:

- 1) Planck's constant, $h = 6.634 \times 10^{-34} \text{ Js}$.
- 2) Free space permittivity, $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$.
- 3) Mass of electron, $m_e = 9.1 \times 10^{-31} \text{ Kg}$.
- 4) Charge on electron, $e = 1.602 \times 10^{-19} \text{ C}$.
- 5) Velocity of light, $c = 3 \times 10^8 \text{ m/s}$.

1. A) Write down the Schrodinger time independent wave equation for matter waves. Hence obtained the expression for energy of the particle in one dimensional potential well of infinite height. **6**
B) Define Phase velocity and Group velocity and derive the relation between them. **6**
C) Consider an electron is confined to one dimensional box of length 10^{-10} m . Calculate the lowest two energy of the system. **4**

OR

2. A) Describe the Davisson-Germer experiment which supports the existence of matter waves. **6**
B) State Heisenberg's Uncertainty principle and prove that electrons do not exist inside the nucleus. **6**
C) Calculate the de Broglie wavelength of electron accelerated through a potential difference of 54 Volts. **4**
3. A) Derive an expression for the contact potential (V_0) for P-N junction in equilibrium. **6**
B) Show that the fermi level E_F lies exactly midway between conduction band and valence band in intrinsic semiconductor **6**
C) Estimate the fraction of electron in the conduction band at 300k of Germanium ($E_g = 0.72 \text{ eV}$) **4**

OR

4. A) Write down the Fermi Dirac distribution function and define Fermi energy. 4
- B) Draw energy band diagram for p-n junction diode in unbiased and biased mode. 4
- C) Derive an expression for conductivity in semiconductor 4
- D) Find the resistivity of intrinsic germanium at 300K. Given that the intrinsic density of carrier is $2.5 \times 10^{19} / \text{m}^3$, electron mobility is $0.39 \text{m}^2 / \text{V} \cdot \text{sec}$ and hole mobility is $0.19 \text{m}^2 / \text{V} \cdot \text{sec}$. 4
5. A) Show that the FCC structure is more closely packed than BCC structure. 6
- B) What are Miller Indices? Draw the planes for (100), (101). 6
- C) X-rays of 1.5 \AA are incident on NaCl crystal having grating spacing of 2.8 \AA . What is the highest order that the crystal can diffract? 4

OR

6. A) Derive Bragg's Law. 6
- B) Deduce the relation between interplanar distance, d and the Miller Indices of the planes of cubic crystal. 6
- C) Aluminum has FCC structure. Its density is 2700 kg/m^3 . Calculate the unit cell dimension and the diameter. Atomic weight of Aluminium = 26.98. 4
7. A) What is antireflection coating? Obtain condition for minimum thickness for such coating. 6
- B) What is thin film? Derive an expression for optical path difference in plane parallel thin film. 6
- C) Newton's rings are observed in reflected light of wavelength 590 nm. The diameter of the 10th ring is 0.6 cm. Find the radius of curvature of lens. 4

OR

8. A) Explain by drawing a suitable diagram the focusing action of symmetrical electron lens. 6
- B) Explain the concept of Velocity Filter with neat labeled diagram. 4
- C) Define Electron Volt. 2
- D) A proton accelerates from rest in a uniform electric field of 100 V/m. Find the acceleration of proton. 4
9. A) Explain the following terms: 6
 - i) Population inversion
 - ii) pumping
 - iii) optical resonator.

- B) Explain construction and working of semiconductor laser. **6**
- C) Imagine that we chop a continuous laser beam of wavelength 623.8 nm into 0.1 ns pulses using some sort of shutter. Compute the coherence length and band width. **4**

OR

- 10.** A) Differentiate between step index fibre and graded index fibre. **3**
- B) Deduce the expression for acceptance angle of an optical fiber. **6**
- C) What is attenuation. **3**
- D) A glass clad fibre is made with core glass of R.I. 1.5 and cladding is doped to give a fractional index difference of 0.0005, find i) cladding index and ii) acceptance angle. **4**
