B.E. / B.Tech. (Model Curriculum) Semester - I & II

BSC101 - Physics

P. Pages : 3 **GUG/S/23/13165**

Time : Three Hours * 1 6 0 8 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of non programmable calculator is permitted.
6. Diagrams should be given wherever necessary.

List of Constants:

1) Planck's constant $(h) = 6.634 \times 10^{-34}$ Js
2) Free space permittivity $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m
3) Mass of electron $(m_e) = 9.11 \times 10^{-31}$ kg
4) Charge on electron $(e) = 1.602 \times 10^{-19}$ C
5) Velocity of light $(c) = 3 \times 10^{8}$ m/s

1. a) What is matter wave? Explain its significance with change in mass of a particle. Show that the de Broglie's wavelength for the electron is found to be equal to $\frac{12.26}{\sqrt{v}}$ Å. **6**

b) State the Heisenberg uncertainty principle. Explain why Heisenberg uncertainty principle is significant for microscopic particles and not for heavy bodies. **6**

c) Calculate the de Broglie wavelength associated with an alpha particle (q=2e) accelerated by a potential difference of 25KV. Mass of alpha particle is 6.68×10^{-27} kg. **4**

OR

2. a) i) What is a wave function? **6**
ii) Write the physical significance of wave function φ.

b) Write down the time independent Schrodinger's wave equation. Show that the energy of a microparticle confined in an infinite one-dimensional potential well of length 'l' is given by $E_n = \frac{n^2 h^2}{8mL^2}$ where symbols have their usual meaning. **6**

c) The speed of an electron is measured to be 5×10^{3} m/s to an accuracy of 0.003%. Find the uncertainty in the determination of the position of this electron. **4**

3. a) What is fermi function? Draw graph showing its variation with energy at different temperatures. Show that the fermi function is symmetric at $E = E_F$. **6**

b) Explain the term drift current and diffusion current. Write the expression for the electrical conductivity of an intrinsic semiconductor. **6**

c) Find the resistivity of intrinsic germanium at 300k The electron and hole mobilities are $0.39m^2$ / V.s and $0.19m^2$ / V.s respectively. The intrinsic carrier density for germanium is 2.5×10^{19} / m^3. **4**

OR

4. a) Give Reasons for **6**
i) In a transistor base is thin and lightly doped.
ii) In a transistor collector has large area of cross section.
iii) The emitter base junction is forward biased and base collector junction is reverse biased.

b) Draw neat energy band diagram for pn junction when **6**
i) Unbaised ii) forward biased iii) Reverse biased

c) What is the probability of an electron being thermally excited to the condition band in silicon at 300K? The band gap energy is 1.12eV. **4**

OR

5. a) i) What is meant by dipole moment? **6**
ii) What are non-polar dielectrics?
iii) What are polar dielectrics?

b) Derive relation between $\vec{D}, \vec{E}$ & $\vec{P}$ vectors. Also derive relation between susceptibility ψ dielectric constant, ϵ_r. **6**

c) A parallel plate capacitor has an area of $6.45\times10^{-4}m^2$ and plate separation of $2\times10^{-3}m$ and across the plates a potential of 12V is applied. If a material having a dielectric constant 5 is placed within the region between the plates. Calculate the capacitance of a capacitor, $\epsilon_0 = 8.85\times10^{-12}$ F / m **4**

OR

6. a) Define piezoelectric effect. Discuss some of the important application of the piezoelectric material. **6**

b) What are the important characteristics of ferroelectric material. **6**

c) Calculate the electronic polarizability of argon atom. Given $\varepsilon_r = 1.0024$ at NTP & $N = 2.7\times10^{25}$ atoms/ m^3. **4**

7. a) Explain the phenomenon of interference in this film of uniform thickness due to reflected light what happens when **6**
i) Monochromatic light is incident normally on the uniform their film.
ii) White light is incident on the film.

b) What is fringe width? What do we mean by wedge shaped air film? A wedge shaped air film is illuminated by monochromatic light. Obtain an expression for the fringe width of interference pattern formed. **6**

c) In a Newton's ring experiment the diameter of 5^{th} ring was 0.336 cm and the diameter of 15^{th} ring was 0.590cm Find the radius of curvature of plane convex lens if the wavelength of light used is 5890Å. **4**

OR

8. a) Discuss the motion of electron projected into uniform electric field at acute angle with the field direction. **6**

b) How a charged particle can be made to travel along helical path in an uniform magnetic field? Obtain an expression for pitch of helix. **6**

c) An electron travelling with a velocity of $1.8\times10^{4}\ \mathrm{m/s}$ enters uniform electric field of strength 0.003 N/C and moves in the direction opposite to field lines. **4**

i) What is the acceleration of the electron?
ii) What is velocity after travelling a distance of 7.1cm in the electric field.
iii) How much time will take to cover the above distance.

9. a) Define and explain **6**

i) Spontaneous Emission
ii) Stimulated emission
iii) Population inversion

b) Explain the construction and working of He-Ne laser? **6**

c) With a He-Ne laser, fringes remain clearly visible. When the path difference was increased upto 8m (given $\lambda = 11.5\times10^{-7}\ \mathrm{m}$) . Deduce **4**

i) Coherence time (t)
ii) Spectral half width $\Delta\lambda$.

OR

10. a) What is meant by attenuation in optical fibre? State the factors responsible for losses in optical fibre. **6**

b) Explain what is **6**

i) Step index
ii) Gradded index
iii) Attenuation &
iv) Acceptance cone

Draw relevant sketches.

c) Calculate the numerical aperture, fractional refractive index and acceptance angle of an optical fibre from the following data. **4**

$n_1(\mathrm{core}) = 1.55$ $n_2(\mathrm{cladding}) = 1.50$

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