BRAINWARE UNIVERSITY

Term End Examination 2023-2024
Programme – B.Tech.(RA)-2023
Course Name – Physics I
Course Code - BSCR101
(Semester I)

Full Marks : 60

Time : 2:30 Hours

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question)

1 x 15=15

1. Choose the correct alternative from the following :

(i) The nature of the wave front due to a point source of light is
   a) Spherical
   b) Plane
   c) Cylindrical
   d) None of these

(ii) In a ruby laser, population inversion is achieved by
   a) Optical pumping
   b) Inelastic atom-atom collision
   c) Chemical reaction
   d) Applying strong electric field

(iii) The time period of a simple pendulum of infinite length is given by
   a) Finite
   b) Zero
   c) Infinite
   d) None of these

(iv) The amplitudes of two travelling waves are in the ratio 1:2. Compare the ratio of their intensities
   a) 1:2
   b) 2:1
   c) 4:1
   d) 1:4

(v) Out of the following, which factor is not responsible for attenuation loss in optical fiber?
   a) absorption loss
   b) scattering loss
   c) microbend loss
   d) reflection loss

(vi) If white light is used in Newton's rings experiment, then
   a) A number of coloured rings will be observed
   b) No rings will be observed
   c) Black and white rings will be observed
   d) None of these

(vii) $E = h \upsilon$ can be rewritten as
   a) $E = h \lambda / c$
   b) h / ω
   c) $h \omega / 2 \pi$
   d) $h f / 2$

(viii) Which of the following is not essential for simple Harmonic motion?
   a) Inertia
   b) Gravity

122 - 31

c) Restoring force

d) Elasticity

(ix) Max Planck's great discovery was that radiation energy is emitted in packets. That packet of energy of is also recognized as

a) Photons

b) Gamma rays

c) Quanta

d) Wave functions

(x) Select the medium in which the propagation speed of sound is maximum.

a) Gas

b) Liquid

c) Solid

d) Plasma

(xi) Identify the correct relation between total energy [E] and temperature [T] in Stefan- Boltzmann law.

a) $E \propto T^4$

b) $E \propto T^{-4}$

c) $E \propto T$

d) $E \propto T^{-1}$

(xii) Identify the correct momentum-energy relation.

a) $E = \sqrt{p^2 c^2 + m_0^2 c^4}$

b) $E = \sqrt{p^2 c^2 - m_0^2 c^4}$

c) $E = \sqrt{p^2 c^2 + m_0 c^4}$

d) $E = \sqrt{pc + m_0 c^4}$

(xiii) In Fresnel diffraction the source of light is effectively at

a) Finite distance

b) Infinite distance

c) Both finite and infinite

d) None of these

(xiv) The wavelength of of He-Ne laser is

a) 430 nm

b) 500 nm

c) 600 nm

d) 632.8 nm

(xv) In optical fiber, the principle of light that is applied is

a) Scattering

b) Successive reflection

c) Refraction

d) Total internal reflection

Group-B
(Short Answer Type Questions)   3 x 5=15

2. Explain population inversion in a laser. (3)

3. Determine the de Broglie wavelength of a thermal neutron at temperature 600 K? (3)

4. Show that the displacement and velocity graph of a simple harmonic oscillator is elliptical. (3)

5. Calculate the numerical aperture, the acceptance angle, and the critical angle of an optical fibre having refractive indices 1.5 (core) and 1.45 (cladding). Consider the surrounding medium as air. (3)

6. Deduce the missing orders for a double-slit Fraunhofer diffraction pattern if the slit widths are 0.16 mm and they are 0.8 mm apart. (3)

OR

Explain the terms a) Ordinary Ray and b) Extraordinary Ray. (3)

Group-C
(Long Answer Type Questions)

5 x 6=30

7. Write down Schrödinger's equation for a free particle in a one-dimensional potential box. (5) Applying appropriate boundary conditions calculate its Eigen energies.

8. With the help of uncertainty principle, infer that no electron exists in the nucleus of an atom. (5)

9. Sate the conditions for over damped, critically damped and under damped motion. (5)

10. Show that the relation between group velocity (v_g) and phase velocity (v_p) is $v_g = v_p - \lambda \dfrac{dv_p}{d\lambda}$ (5)

11. In Young's double slit experiment, the two slits 0.15 mm apart are illuminated by monochromatic light of wavelength 450 nm. The screen is 1 m away from the slits. Calculate the distance of the second bright from the central maximum. (5)

12. Deduce the relation between the various Einstein's coefficients of absorption and emission of (5) radiation.

OR

In a He-Ne laser transition from E_3 to E_2 level gives a laser emission of wavelength 632.8 (5) nm. If the energy of the E_2 level is 15.2×10^{-19} J, Evaluate the required pumping energy if there is no energy loss in He- Ne laser.

****