

B. TECH.
(SEM I) THEORY EXAMINATION 2022-23
PHYSICS

Time: 3 Hours**Total Marks: 100****Note:** Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief. 2 x 10 = 20

- (a) What are the negative results of the Michelson-Morley experiment?
- (b) What are the massless particles?
- (c) What do you understand by displacement current?
- (d) Define the Poynting vector.
- (e) What do you understand by a black body?
- (f) State Wein's displacement law.
- (g) What are the coherent sources?
- (h) What is Rayleigh's criterion of resolution?
- (i) Define population inversion.
- (j) What is the dispersion in optical fibers?

SECTION B

2. Attempt any three of the following: 10x3=30

- (a) Show that momentum of a particle (p) of rest mass (m_0) and energy (E) is given by $E^2 = m_0^2 c^4 + p^2 c^2$.
- (b) If the magnitude of H in a plane wave is 1 amp/meter, find the magnitude of E for a plane wave in free space. (Where $\mu_0 = 4\pi \times 10^{-7}$ Weber/amp-m and $\epsilon_0 = 8.85 \times 10^{-12}$ C/N-m²).
- (c) Calculate the de-Broglie wavelength associated with a proton moving with a velocity equal to $1/20^{\text{th}}$ of the velocity of light.
- (d) Calculate the wavelength of light whose first diffraction maximum in the diffraction pattern due to a single slit falls at 30° and coincides with the first minimum of red light of wavelength $6500\text{\AA}$.
- (e) Calculate the numerical aperture, acceptance angle, and critical angle of the fiber from the following data: μ_1 (core refractive index) = 1.50 and μ_2 (cladding refractive index) = 1.45.

SECTION C

3. Attempt any one part of the following: 10x1=10

- (a) Derive the Lorentz Transformation equations and show that Lorentz Transformation approaches to Galilean Transformation when the velocity (v) $\ll c$.
- (b) Derive a suitable expression for time dilation and show that time dilation is a real effect.

4. Attempt any *one* part of the following: 10x1=10

- (a) Derive the expression for the Poynting theorem in electromagnetic waves.
- (b) Show that electromagnetic waves are transverse in nature.

5. Attempt any *one* part of the following: 10x1=10

- (a) Derive the time-independent Schrodinger equation, for matter waves.
- (b) Derive a suitable expression for Planck's radiation law.

6. Attempt any *one* part of the following: 10x1=10

- (a) What are Newton's rings? How they are formed? Derive the expressions for the diameter of bright and dark rings in reflected monochromatic light.
- (b) Derive the conditions of principal maxima and minima for the diffraction due to a grating.

7. Attempt any *one* part of the following: 10x1=10

- (a) What is an optical fiber? Derive the expression for the numerical aperture, acceptance angle, and critical angle of an optical fiber.
- (b) Discuss the construction and working of the He-Ne laser and give its advantages over the Ruby laser.