

EPHY 101

B. Tech. (Ist SEMESTER) EXAMINATION, 2025-26

Bachelor of Technology

(CSE & ME)

Engineering Physics

Time : Three Hours]

[Maximum Marks : 75

Note: There are **three** sections (A, B and C) and candidate has to attempt questions from all sections. Marks are indicated against each section.

Section-A

1. Attempt all of the following : 5×3=15
- (a) Define the frames of reference and differentiate between inertial and non-inertial frames.
 - (b) What is the blackbody radiation ? Explain the Rayleigh-Jeans law.
 - (c) Write the expression for the gradient theorem, divergence theorem and stokes (curl) theorem.
 - (d) What do you mean by laser ? Write about spontaneous and stimulated emission.
 - (e) Write modified Maxwell's equations in differential form.

Section-B

Note: Attempt all questions :

4×5=20

2. (a) Show that space-time interval is invariant under Lorentz transformation.

Or

- (b) With what velocity a particle should move so that its mass appears to increase by 20% of its rest mass ?

3. (a) Derive the expression for the wave-length of de-Broglie Waves and also derive the expression for wavelength of an electron which is accelerating with a potential difference V (volt).

Or

- (b) Derive the solution of Schrödinger wave equation for particle in one-dimensional box and write the energy for ground state and first excited state for an electron.

4. (a) Derive the expression of line element, surface element and volume element in spherical polar coordinate system. Also calculate the volume of sphere which radius is R .

Or

- (b) Obtain the expression for the fringe width using Young's double slit experiment. Discuss the intensity variation in the interference patterns for the constructive and destructive interference.
5. (a) Describe the laws of electromagnetic induction for self and mutual inductance.

Or

- (b) Derive the expression for the velocity addition theorem from one reference frame S to other reference frame S' .

Section-C

Note: Answer any two questions :

2×20=40

6. Normalise the wave function
 $\psi(x) = 0$ outside the box of size L
 $\psi(x) = A \sin kx$ for $0 < x < L$
Where $k = \frac{\pi}{L}$

And also derive time dependent and time-independent Schrödinger wave equations.

7. Establish the Einstein's mass-energy relation. Show that $E^2 - p^2c^2$ for the group of particle is invariant under Lorentz transformation.
8. Show that a vector field is given by $\vec{A} = yz\hat{i} + xz\hat{j} + xy\hat{k}$, both irrotational and solenoidal. Establish the electromagnetic waves equations in free space and solve them to show that they travel with the speed of light in free space and are transverse in nature.
9. Discuss the interference and diffraction phenomenon of light. Deduce the ratio of maximum to minimum intensities in fringe system. When the ratio of intensities of two waves are given as 16:1, Discuss the interference in a Wedge-Shaped thin film and obtain the expression for the fringe width. Calculate the fringe-width when two glass plate enclose a wedge-shaped air film touching at one edge are separated by a wire of 0.03mm diameter at distance 15cm from the edge. Monochromatic light ($\lambda = 6000\text{\AA}$) from a broad source falls normally on the film.

