TPH 101 Printed Pages : 6

Paper ID & Roll No. to be filled in your Answer Book

Roll No. | | | | | | | | | | |

B.Tech. (1st Sem.)

End Term Examination

Engineering Physics

Time : Three Hours] [Max. Marks : 100

Note: Attempt all questions. The marks assigned to each question are indicated at question itself.

1. Attempt any four. [5×4]

(a) A 2000 kg car moving at 20 m/s collides and locks together with a 1500 kg car at rest at a stop sign. Show that the momentum is conserved in a reference frame moving at 10 m/s in the direction of moving car.

(b) Derive the length contraction and time dilation using Lorentz transformation equations.

(c) Show that a particle with rest mass zero must travel with velocity of light.

(d) What is the maximum speed that a particle can have such that its kinetic energy can be written as $\frac{1}{2} m_0 v^2$ with an error no greater than 0.5%?

(e) (i) Plot the energy density of black body radiation as a function of frequency at two thermal equilibrium temperatures T_1 and T_2 where $T_2 > T_1$. [2]

(ii) Obtain the formula for Rayleigh-Jeans' law from Planck's radiation law. [3]

(f) Consider a photon that is scattered from an electron at rest. If the Compton's wavelength shift is observed to be 1% of the wavelength of the incident photon and if the photon is scattered at 60°, calculate (a) the wavelength of the incident photon (b) the energy of the recoiling electron.

2. Attempt any four. [5×4]

(a) Discuss are the important results of Young's double slit experiment.

(b) A screen containing two slits 0.100 mm apart is 1.20 m from the viewing screen. Light of wavelength A =

3. Attempt any two. [10×2]

(a) (i) Discuss the production methods of linearly, circularly and elliptically polarized lights.

(ii) Unpolarized light passes through two Polaroids; the axis of one is vertical and that of the other is at 60° to the vertical. Describe the orientation and intensity of transmitted lig

(b) (i) Explain the phenomenon of double refraction. [5]

(ii) Define the term "specific rotation" and discuss the working principle of polarimeter. [5]

(c) (i) Why is it easier to obtain laser light in the red region? Explain your answer on the basis of spontaneous emission and stimulated emission coefficients. [3]

(ii) Explain the working principle of Ruby laser with the help of energy level diagram.

Label your diagram showing all the details. [7]

4. Attempt any two. [10×2]

(a) (i) What was the need to modify the Ampere's law? [4]

(ii) A uniform wave in air is given by $E = 10\cos(2\pi \times 10^6 t - \beta z)\hat{a}_y$. What are the directions of propagation and polarization? Calculate b and l. [6]

(b) Consider a monochromatic plane wave with frequency w traveling in the z-direction and polarized in x-direction, incidents normally at an air-glass interface. Calculate the exact reflection and transmission coefficients R and T without assuming $m_1 = m_2 = m_o$. Confirm that R + T =1.

(c) (i) Explain the classical Langevin's theory of diamagnetism. [7]

(ii) Classify the magnetic materials in terms of their susceptibility. [3]

5. Attempt any two. [10×2]

(a) What are type-I and type-II superconductors? Explain Meissner effect and isotope effect. [4+3+3]

(b) (i) Explain the significance of London equations.

(ii) Using BCS theory, explain about the cooper pairs and the energy gap in a superconductor. [4+6]

(c) (i) Find the deBroglie wavelength of a wave associated with a base ball of mass 10 grams moving with a velocity of 10 m/s and an electron moving with a KE of 2 eV. Explain the results in detail. [4]

(ii) Derive the expression for the wave function for a particle trapped in a one-dimensional box of width L. Draw the values of wave function and its sqaure for different values of *n*. [4+2]

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500 nm falls on the slits from a distant source. Approximately how far apart will adjacent bright interference fringes be on the screen?

(c) A soap bubble appears green (l = 540 nm) at the point on its front surface nearest the viewer. What is the smallest thickness the soap bubble film could have? Assume n = 1.35.

(d) Show that the angular full width at half maximum of the central peak in a double-slit interference pattern is given by $Dq = l/2d$ if $l << d$.

(e) Light shines through a rectangular hole that is narrower in the vertical direction than the horizontal (i) Would you expect the diffraction pattern to be more spread out in the vertical direction or in the horizontal direction? (ii) Should a rectangular loudspeaker horn at a stadium be high and narrow, or wide and flat? [2.5 + 2.5]

(f) Yellow sodium light, which consists of two wavelengths, l_1 = 589.00 nm and l_2 = 589.59 nm, falls on a 7500-line/cm diffraction grating. Determine (i) the maximum order *m* that will be present for sodium light (ii) the width of grating necessary to resolve the two sodium lines. [2.5 + 2.5]