END Semester Examination

Programme: B.Tech

Semester :II

Course Code: PH 19001

Course Name: Optics and Modern Physics

Branch: F. Y. B Tech (All branches+Backlogs)

Academic Year: 2021-22

Duration: 3 Hrs

Max Marks: 60

Student PRN No.

| 1	1	2	1	1	0	0	5	6

Instructions:

1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of stationery, calculator etc. not allowed.
5. Write your PRN Number on Question Paper.

			Marks	CO	PO

Q1 a Obtain the condition for maxima and minima in case wedge shaped thin film with neat labelled diagram. **6 1**

b Write expression for intensity as a function of phase angle φ for single slit diffraction and show that relative intensity varies with order of diffraction. **4 1**

OR

Diffraction grating has 4000 lines per cm. The angle between the central maximum and the third order maximum is 36^0. What is the wavelength of the light? **4 1**

Q2 a Find out the state of polarization represented by the following set of equations: **4 2**

$E_x = E \cos(\omega t - kz)$ & $E_y = E \cos(\omega t - kz + \pi/4)$

b What is Quarter wave plate and half wave plate? Explain the use of Quarter wave plate in conversion of plane polarized light to Circularly/Elliptically polarized light. **3 2**

c A plane polarized light is incident perpendicularly on a quartz plate cut with faces parallel to optic axis. Find the thickness of quartz plate, which introduces phase difference of 60^0 between o-ray and e-ray.($\mu_e = 1.553$, $\mu_o = 1.544$, $\lambda = 5400$Å) **3 2**

Q3 a Explain the principle, construction and working of Helium Neon Laser. **6 3**

b A three level laser emits laser light at a wavelength of 550 nm, if optical pumping mechanism is shut down what will be the ratio of population of upper level to that of lower level, (T = 300^0K). Given (k= 1.38×10^{-23} J/^{0}k, h = 6.62×10^{-34} J–Sec, c = 3×10^{8} m/s) **4 3**

Q4 a In following figure (a)-(d), wave functions are sketched as a function of x, which is/are   4   4
acceptable wave function and give justification for each plot?
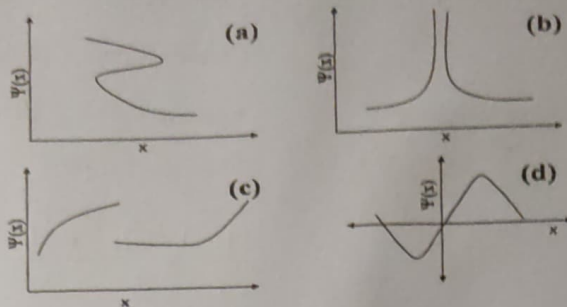
b What is the de Broglie wavelength associated with an electron accelerated through 54V   3   4
volts. Given : $h= 6.625 \times 10^{-34}$ J-s, mass of electron $=9.1 \times 10^{-31}$kg, $e = 1.6 \times 10^{-19}$ C

c What are operators? Obtain an expression for momentum and energy operator.   3   4

Q5 a A particle travelling with energy $E > V_0$, has a potential barrier defined as   4   4

$$V = 0 \qquad\qquad x < 0$$
$$V = V_0 \qquad\qquad 0 \leq x \leq a$$
$$V = 0 \qquad\qquad x > a$$

Write the Schrödinger's wave equations and its solutions for all the three regions.

b Lowest energy of an electron trapped in a infinite potential well is 38 electron Volt.   3   4
Calculate the width of the well.

Given : $h= 6.625 \times 10^{-34}$ J-s, mass of electron $=9.1 \times 10^{-31}$kg, $e = 1.6 \times 10^{-19}$ C

c A small object of mass 1 μg is confined to move between two rigid walls separated by a   3   4
distance of 1mm. Calculate the minimum speed of the object.

Given : $h= 6.625 \times 10^{-34}$ J-s

Q6 a What is Piezo-electric effect? Explain principle, construction and working of Piezo-   6   5
electric oscillator.

b If Young's modulus of iron is 115×10^9 N/m² and its density is 7.25×10^3 kg/m³ . Find   4   5
the length of an iron rod which can produce ultrasonic waves of 20 kHz.

OR

Suppose a wedge shaped air film is made between two sheets of glass with a piece of   4   1
paper 7.618×10^{-5} m thick used a the spacer at their very ends. If light of wavelength
500nm is incident normally. Determine the number of fringes that will be seen across
the wedge.