

Name:	
Enrolment No:	

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**  
**End Semester Examination, January 2021**

**Course: PHYSICS I**

**Semester: I**

**Course Code: PHYS1020**

**Programme: BTech :APE UP, EC, EE, ASE, ASE+AVE**

**Max. Marks: 100**

**Total pages: 2**

**Time: 03 hrs.**

**Instructions:**

- All questions are compulsory (**Q12** has internal choice)
- Use blank paper as rough work to solve the questions in section-A and write only the correct options (type answers, no upload)

**SECTION A**

S. No.		Marks	CO
Q1.	Write down the characteristics of a laser beam	<b>5</b>	<b>CO1</b>
Q2.	Magnetization of a paramagnetic salt at temperature 300K in a magnetic field of 0.4 T (Curie's constant is $3 \times 10^{-3}$ K) is (a) 3.5 A/m      (b) (3.2 A/m)      (c) 3.6 A/m      (d) 3.8 A/m	<b>5</b>	<b>CO2</b>
Q3.	The Displacement current density $\vec{J}_d$ from the given electric field, $\vec{E} = E_0 \sin(kx - 10^{12}t)\hat{j}$ associated with an electromagnetic wave travelling through a medium of relative dielectric permittivity 2 will be (a) $\vec{J}_d = 17.7 E_0 \cos(kx - 10^{12}t)\hat{j} A/m^2$ (b) $\vec{J}_d = 1.77 E_0 \cos(kx - 10^{12}t)\hat{j} A/m^2$ (c) $\vec{J}_d = 177 E_0 \cos(kx - 10^{12}t)\hat{j} A/m^2$ (d) $\vec{J}_d = 17.7 E_0 \sin(kx - 10^{12}t)\hat{j} A/m^2$	<b>5</b>	<b>CO2</b>
Q4.	Choose the correct normalization constant N for $\Psi(x) = Ne^{-x^2/a^2}$ as (a) $N = \sqrt{\frac{1}{2a\pi}}$ (b) $N = \sqrt{\frac{1}{a\sqrt{2\pi}}}$ (c) $N = \sqrt{\frac{1}{a} \sqrt{\frac{2}{\pi}}}$ (d) $N = \sqrt{\frac{1}{2a\sqrt{\pi}}}$	<b>5</b>	<b>CO3</b>
Q5.	A plane with Miller indices of [102] cuts the crystal axes X, Y, Z with the intercepts of a, b, c. The correct intercepts are (a) (2, $\infty$ , 1)      (b) (1, $\infty$ , 2)      (c) ( $\infty$ , 1, 2)      (d) ( $\infty$ , 2, 1)	<b>5</b>	<b>CO4</b>
Q6.	Choose the correct ratio of atomic radius (r) to lattice constant (a) of a BCC crystal as (a) $r/a = \sqrt{3/18}$ (b) $r/a = \sqrt{3/8}$ (c) $r/a = \sqrt{3/4}$ (d) $r/a = \sqrt{3/16}$	<b>5</b>	<b>CO4</b>

<b>SECTION B</b>			
Q7.	Describe construction and working of He-Ne laser.	<b>10</b>	<b>CO1</b>
Q8.	Deduce relation between Einstein A and B coefficients describing the processes of absorption, spontaneous emission, and stimulated emission.	<b>10</b>	<b>CO1</b>
Q9.	Prove that an electromagnetic wave propagating in free space follows $\vec{k} \times \vec{E} = \omega \vec{B}$ (you may consider, $\vec{E}$ along X, $\vec{B}$ along Y and propagation along Z directions).	<b>10</b>	<b>CO2</b>
Q10.	Give the construction and working of a Solar Cell.	<b>10</b>	<b>CO3</b>
Q11.	What is Atomic Packing Fraction (APF)? Obtain APF for FCC crystal.	<b>10</b>	<b>CO4</b>
<b>SECTION-C</b>			
Q12.	(a) Derive Schrodinger time independent wave equation.	<b>10</b>	<b>CO3</b>
	(b) Find the probability of finding a particle trapped in a 1D box of length L between L/4 to L/2 using ground state wave function.	<b>10</b>	<b>CO3</b>
	<b>OR</b>		
	(a) Derive the expression for Compton shift.	<b>10</b>	<b>CO3</b>
	(b) Calculate minimum uncertainty in its position if an electron moves with a speed of 0.02c. Maximum uncertainty in speed = 0.01%.	<b>10</b>	<b>CO3</b>
Physical constants: $h = 6.63 \times 10^{-34} \text{ J-s}$ , $c = 3 \times 10^8 \text{ m/s}$ , $k_B = 1.38 \times 10^{-23} \text{ J/K}$ , $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$ $\epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$ , mass of proton = $1.6726 \times 10^{-27} \text{ Kg}$			