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	**5**	**CO1**
Q2.	Magnetization of a paramagnetic salt at temperature 300K in a magnetic field of 0.4 T (Curie's constant is 3×10^{-3} K) is (a) 3.5 A/m (b) (3.2 A/m) (c) 3.6 A/m (d) 3.8 A/m	**5**	**CO2**
Q3.	The Displacement current density $\overrightarrow{J_d}$ from the given electric field, $\vec{E} = \boldsymbol{E_0 Sin\,(kx - 10^{12}t)\hat{j}}$ associated with an electromagnetic wave travelling through a medium of relative dielectric permittivity 2 will be (a) $\overrightarrow{J_d} = 17.7\,\boldsymbol{E_0 Cos\,(kx - 10^{12}t)\hat{j}}\ A/m^2$ b)) $\overrightarrow{J_d} = 1.77\,\boldsymbol{E_0 Cos\,(kx - 10^{12}t)\hat{j}}\ A/m^2$ (c)) $\overrightarrow{J_d} = 177\,\boldsymbol{E_0 Cos\,(kx - 10^{12}t)\hat{j}}\ A/m^2$ (d)) $\overrightarrow{J_d} = 17.7\,\boldsymbol{E_0 Sin\,(kx - 10^{12}t)\hat{j}}\ A/m^2$	**5**	**CO2**
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) $N = \sqrt{\frac{1}{2a\sqrt{\pi}}}$	**5**	**CO3**
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, ∞, 1) (b) (1, ∞, 2) (c) (∞, 1, 2) (d) (∞, 2, 1)	**5**	**CO4**
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) $r/a = \sqrt{3/16}$	**5**	**CO4**

SECTION B			
Q7.	Describe construction and working of He-Ne laser.	**10**	**CO1**
Q8.	Deduce relation between Einstein A and B coefficients describing the processes of absorption, spontaneous emission, and stimulated emission.	**10**	**CO1**
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).	**10**	**CO2**
Q10.	Give the construction and working of a Solar Cell.	**10**	**CO3**
Q11.	What is Atomic Packing Fraction (APF)? Obtain APF for FCC crystal.	**10**	**CO4**
SECTION-C			
Q12.	(a) Derive Schrodinger time independent wave equation.	**10**	**CO3**
	(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.	**10**	**CO3**
	OR		
	(a) Derive the expression for Compton shift.	**10**	**CO3**
	(b) Calculate minimum uncertainty in its position if an electron moves with a speed of 0.02c. Maximum uncertainty in speed = 0.01%.	**10**	**CO3**

Physical constants: $h = 6.63 \times 10^{-34}\ J-s,\ c = 3 \times 10^{8}\ m/s,\ k_B = 1.38 \times 10^{-23}\ J/K, \mu_0 = 4\pi \times 10^{-7} H/m$ $\varepsilon_0 = 8.854 \times 10^{-12} F/m$, mass of proton= 1.6726 x 10^{-27} Kg