Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

Course: PHYSICS (PHYS 1008) **Semester: I**

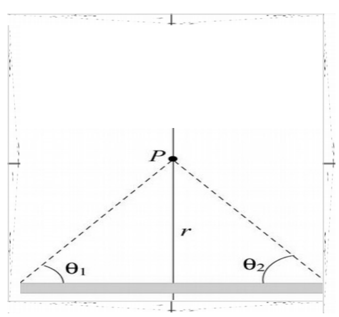
Programme: B. Tech (SoCS) [CS-CSF, Bigdata, OGI, Devops, AI+ML, OSOS & IOT] **Time: 03 hrs.**

Number of pages: 2 **Max. Marks: 100**

SECTION A (All questions are compulsory)

S. No.		**Marks**	**CO**
Q1	Name and explain briefly the pumping mechanisms used in Ruby laser and He-Ne laser?	**4**	**CO1**
Q2	The numerical aperture of a fiber is 0.25 and relative refractive index is 0.02. Determine the refractive indices of the core and cladding of a fiber.	**4**	**CO1**
Q3	Explain de-Broglie's hypothesis. Obtain an expression for de-Broglie's wavelength of an electron.	**4**	**CO4**
Q4	Define Nanomaterial? Give 3 applications of Nanotechnology?	**4**	**CO5**
Q5	Distinguish between classical and Quantum computing?	**4**	**CO5**

SECTION B (All Questions are compulsory with an internal choice in question 9 & 10**)**

Q6	Explain about the different types of optical fibers.	**8**	**CO1**
Q7	A conductor in the shape of a square loop of edge length ℓ = 0.400 m carries a current I = 10 A as in the figure. Calculate the magnitude and direction of the magnetic field at the center of the square.  	**8**	**CO3**
Q8	State Heisenberg's uncertainty principle. On its basis, prove that the electron cannot exist in the nucleus of an atom.	**8**	**CO4**
Q9	Explain the construction and working or He-Ne laser. **(OR)** Calculate the ratio of rate stimulated to spontaneous emission at a temperature of 300°C for Sodium D line.	**8**	**CO1**

Q10	In a certain conducting region, **H** = $yz(x^2 + y^2)$ $\mathbf{a_x}$ - y^2xz $\mathbf{a_y}$ + $4x^2y^2$ $\mathbf{a_z}$ A/m and **J** = $(8x^2y+xy^2)$ $\mathbf{a_x}$ + $(y(x^2 + y^2) - 4xy^2)$ $\mathbf{a_y}$ + $(-y^2z - z\,(x^2 + y^2))$ $\mathbf{a_z}$. (i) Find the current passing through x = -1, 0 < (y, z) < 2, and (ii) Show that $\nabla \bullet \mathbf{H} = 0$. **(OR)** Evaluate the curl of the vector, $n^{\rightarrow}$ ¿ $xy\,a_x + y^2 a_y - xz\,a_z$. Is the curl of the given vector rotational or irrotational.	**8**	**CO3**
SECTION-C (All Questions are compulsory with an internal choice in Question 12**)**			
Q11	a. Write Maxwell's equation for time varying fields in differential and integral form clearly stating the laws involved**.** **(10)** b. Consider two kets |ψ> and |ψ'> such that |ψ'>=$e^{i\theta}$|ψ> where θ is a real number. 1. Prove that if |ψ> is normalized, so is |ψ'> 2. Demonstrate that the predicted probabilities for an arbitrary measurements are the same for |ψ> and |ψ'>, therefore, |ψ> and |ψ'> represent the same physical state. **(10)**	**20**	**CO2** **CO5**
Q12	a. Calculate the work function, stopping potential, and maximum velocity of photoelectrons for a light of wavelength 4350Å when it incidents on sodium surface. Consider the threshold wavelength of photoelectrons to be 5420Å. **(10)** b. Shows that in Compton Scattering, the wavelength of scattered photon is given by $\lambda' = \lambda + \frac{h}{m_0 c}(1-\cos\theta)$, where, λ is wavelength of incident photon, θ and ϕ are scattering angle of scattered photon and electron respectively and m_0 is rest mass of electron. **(10)** **(OR)** a. Deduce Time-independent Schrodinger Equation. **(10)** b. *Calculate the probability of finding a particle* ∈ *its ground state* between 0.45L and 0.55L. The particle is trapped inside 1D potential box of length *L*. **(10)**	**20**	**CO4**

Values of constants:

Constant	Standard Values
Planck's Constant (h)	6.63 x 10^{-34} Joule-sec
Permittivity of free space (ε_o)	8.854 x 10^{-12} Farad/meter
Velocity of Light c	3 x 10^{8} m/sec
Boltzmann constant (k_B)	1.38 × 10^{-23} J K^{-1}
Rest mass of an Electron	9.11 x 10^{-31} Kg
Charge of electron	1.6x10^{-19} C

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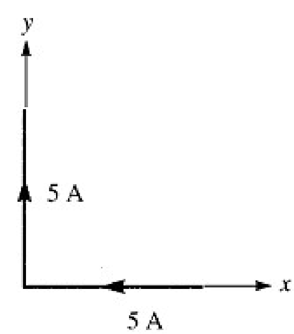
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Physics (PHYS1008) **Semester: I**
Programme: B. Tech (SoCS) [CS-CSF, Bigdata, OGI, Devops, AI+ML, OSOS & IOT] **Time: 03 hrs.**
Number of pages: 2 **Max. Marks: 100**
Instructions:

SECTION A (All questions are compulsory)

S. No.		Marks	CO
Q 1	Explain why it is difficult to achieve laser action for higher frequency?	**4**	**CO1**
Q2	The refractive index of core of step index fibre is 1.50 and the fractions change in refractive index is 4%. Estimate; (a) refractive index of cladding and (b) Numerical aperture.	**4**	**CO1**
Q3	Explain briefly about stopping potential in photoelectric effect experiment. Derive its expression with the help of Einstein's photoelectric equation.	**4**	**CO4**
Q4	(a) Define nanomaterial? Explain the working of SEM.	**4**	**CO5**
Q5	Differentiate between qubit and classical bit	**4**	**CO5**

SECTION B (All Questions are compulsory with an internal choice in question 9 & 10**)**

Q6	What are the types of optical fibers based on refractive index profile? Describe them using schematic diagrams of (i) refractive index profiles of core and cladding, and (ii) path of rays in them.	**8**	**CO1**
Q7	An infinitely long conductor is bent into an L shape as shown in Figure below. If a direct current of 5 A flows in the current, find the magnetic field intensity at (a) (2, 2, 0), and (b) (0, - 2, 0). 	**8**	**CO3**
Q8	Define phase velocity and group velocity of matter waves. Derive the general relation between group velocity and phase velocity?	**8**	**CO4**
Q9	Find the ratio of populations of two states in He-Ne laser that produces light of wavelength 6328 Å at 27°C and 270°C. **(OR)** The coherence length of sodium light is 2.945×10^{-2} m and its wavelength is 5890Å. Calculate (i) the number of oscillations corresponding to coherence length and (ii) the coherence time.	**8**	**CO1**

Q10	Calculate the magnetic field of a long straight wire that has a circular loop with a radius of 0.05m. The current flowing through this wire is given as 5A. **(OR)** A 30-cm by 40-cm rectangular loop rotates at 130 rad/s in a magnetic field 0.06 Wb/ m^2 normal to the axis of rotation. If the loop has 50 turns, determine the induced voltage in the loop.	**8**	**CO3**
SECTION-C (All Questions are compulsory with an internal choice in Question 12**)**			
Q11	a. Derive the expressions for continuity equation and relaxation time. **(10)** b. Consider two kets $\|\psi>$ and $\|\psi'>$ such that $\|\psi'>=e^{i\theta}\|\psi>$ where θ is a real number. 1. Prove that if $\|\psi>$ is normalized, so is $\|\psi'>$ 2. Demonstrate that the predicted probabilities for an arbitrary measurements are the same for $\|\psi>$ and $\|\psi'>$, therefore, $\|\psi>$ and $\|\psi'>$ represent the same physical state. **(10)**	**20**	**CO2** **CO5**
Q12	a. A Particle is moving in one-dimensional potential box (of infinite height) of the width 25 Å. Calculate the probability of finding the particle within an interval of 5 Å at the centers of the box when it is in its state of least energy. **(10)** c. Deduce Time-dependent Schrodinger Equation. **(10)** **(OR)** a. Show that the wave function of a particle trapped into a one-dimension box of length L is $\Psi_n(x)=\sqrt{\frac{2}{L}}\sin\left(\frac{n\pi x}{L}\right)$, where n=1, 2, 3,…. **(10)** b. An electron is confined in a 1D infinite potential box of boundary between 0 and 2 nm. If the particle has 6 nodes find the particle energy in eV. Draw the wave function and probability density diagram for this particle that has 6 nodes. **(10)**	**20**	**CO4**

Values of constants:

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule-sec
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