

Name:	
Enrolment No:	

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

**Course: PHYSICS (PHYS 1002)**

**Programme: B. Tech (SoCS) (CS-CYBER LAW LLB IPR)**

**Number of pages: 2**

**Semester: I**

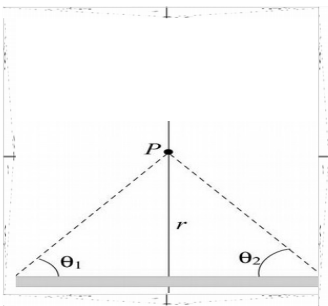
**Time: 03 hrs.**

**Max. Marks: 100**

**SECTION A (All questions are compulsory)**

S. No.	Question	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	Write about the postulates of special Theory of Relativity.	4	CO5
Q5	Derive an expression for the Length contraction.	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	<p>A conductor in the shape of a square loop of edge length <math>\ell = 0.400</math> m carries a current <math>I = 10</math> A as in the figure. Calculate the magnitude and direction of the magnetic field at the center of the square.</p> <div style="text-align: center;">  </div>	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	<p>Explain the construction and working of He-Ne laser.</p> <p style="text-align: center;"><b>(OR)</b></p> <p>Calculate the ratio of rate stimulated to spontaneous emission at a temperature of <math>300^\circ\text{C}</math> for Sodium D line.</p>	8	CO1

Q10	In a certain conducting region, $\mathbf{H} = yz(x^2 + y^2) \mathbf{a}_x - y^2xz \mathbf{a}_y + 4x^2y^2 \mathbf{a}_z$ A/m and $\mathbf{J} = (8x^2y+xy^2) \mathbf{a}_x + (y(x^2 + y^2) - 4xy^2) \mathbf{a}_y + (-y^2z - z(x^2 + y^2) \mathbf{a}_z$ . (i) Find the current passing through $x = -1, 0 < (y, z) < 2$ , and (ii) Show that $\nabla \cdot \mathbf{H} = 0$ .  <b>(OR)</b>  Evaluate the curl of the vector, $\nabla \times (xy \mathbf{a}_x + y^2 \mathbf{a}_y - xz \mathbf{a}_z)$ . Is the curl of the given vector rotational or irrotational.	8	CO3
<b>SECTION-C</b> (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. <b>(10)</b>  b. Derive the Lorentz Transformation Equations. <b>(10)</b>	20	CO2  CO5
Q12	a. Calculate the work function, stopping potential, and maximum velocity of photoelectrons for a light of wavelength $4350\text{\AA}$ when it incidents on sodium surface. Consider the threshold wavelength of photoelectrons to be $5420\text{\AA}$ . <b>(10)</b>  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, $\lambda$ is wavelength of incident photon, $\theta$ and $\phi$ are scattering angle of scattered photon and electron respectively and $m_0$ is rest mass of electron. <b>(10)</b>  <b>(OR)</b>  a. Deduce Time-independent Schrodinger Equation. <b>(10)</b> b. Calculate the probability of finding a particle in its ground state between $0.45L$ and $0.55L$ . The particle is trapped inside 1D potential box of length $L$ . <b>(10)</b>	20	CO4

**Values of constants:**

Constant	Standard Values
Planck's Constant (h)	$6.63 \times 10^{-34}$ Joule-sec
Permittivity of free space ( $\epsilon_0$ )	$8.854 \times 10^{-12}$ Farad/meter
Velocity of Light c	$3 \times 10^8$ m/sec
Boltzmann constant ( $k_B$ )	$1.38 \times 10^{-23}$ J K <sup>-1</sup>
Rest mass of an Electron	$9.11 \times 10^{-31}$ Kg
Charge of electron	$1.6 \times 10^{-19}$ C

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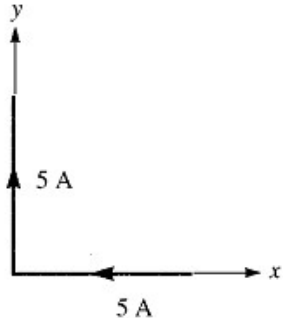
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SECTION A (All questions are compulsory)

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	Distinguish between the Inertial and Non Inertial Frames of References.	4	CO5
Q5	Derive an expression for Time dialation.	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 $6328 \text{ \AA}$ at $27^\circ\text{C}$ and $270^\circ\text{C}$ . (OR) The coherence length of sodium light is $2.945 \times 10^{-2} \text{ m}$ and its wavelength is $5890 \text{ \AA}$ . 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.  <b>(OR)</b> A 30-cm by 40-cm rectangular loop rotates at 130 rad/s in a magnetic field 0.06 Wb/m <sup>2</sup> normal to the axis of rotation. If the loop has 50 turns, determine the induced voltage in the loop.	8	CO3
<b>SECTION-C (All Questions are compulsory with an internal choice in Question 12)</b>			
Q11	a. Derive the expressions for continuity equation and relaxation time. <b>(10)</b> b. Derive an expression for the variation of mass with velocity <b>(10)</b>	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. <b>(10)</b> c. Deduce Time-dependent Schrodinger Equation. <b>(10)</b> <b>(OR)</b> 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,.... <b>(10)</b> 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. <b>(10)</b>	20	CO4

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