Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: B. Tech — **Semester:** II
Program: CCVT, BAO, MAD, BFSI, MT, GG, IFM — **Time** 03 hrs.
Course Code: PHYS1008 — **Max. Marks:** 100

I **Instructions:**

1. Draw the suitable diagram where ever needed.
2. Your answer should be concise and specific to the question.
3. **Bold letters signify vector quantities.**
4. Attempt all the questions of each section. Q. No. 8 and Q. No. 11 are having internal choice.

SECTION A

S. No.		Marks	CO
Q 1	Explain the different types of pumping mechanisms in laser systems.	4	CO1
Q 2	What are the properties of a wave-function?	4	CO4
Q 3	Using the concept of motional emf, prove that $\nabla \times E_m = \nabla \times (u \times B)$, where $\mathbf{E_m}$ is the motional emf.	4	CO3
Q 4	Write the Maxwell's equations for static fields.	4	CO2
Q 5	Prove that the phase velocity of de-Broglie wave exceeds the velocity of light.	4	CO4
	SECTION B		
Q 6	a) An optical fibre has an attenuation 2.2dB/km. If 0.8 mW of optical power is initially launched into the fibre, what is the power level after 4kms? b)With the help of a suitable diagram explain the reconstruction process of a hologram.	5+5	CO1
Q 7	a) Determine the total current in a wire of radius 1.6mm if $J = \frac{500}{\rho} a_z A/m^2$ b) Using Ampere's law and continuity equation, obtain the expression for displacement current density.	5+5	CO3
Q 8	What will be the percentage error if an electron moves with a speed of equivalent KE of 100KeV if someone does not treat the electron relativistically? **OR** A metallic surface, when illuminated with light of wavelength λ_1, emits electrons with energies upto a maximum value E_1, and when illuminated with light of wavelength λ_2, where $\lambda_2 < \lambda_1$, it emits electrons with energies upto a maximum value E_2. Prove that plank's constant h and the work function φ of the metal are given by	10	CO4

	$h=\frac{(E¿¿2-E_1)\lambda_1\lambda_2}{C(\lambda_1-\lambda_2)}¿$ and $\varphi=\frac{E_2\lambda_2-E_1\lambda_1}{(\lambda_1-\lambda_2)}$		
Q 9	Using Gauss's law, derive the expression for electric flux density for infinite sheet of charge.	**10**	**CO2**
	SECTION-C		
Q 10	a) Differentiate between classical computing and quantum computing. b) What are nanomaterials? Give its applications. c) Given the ket $\|\psi\rangle=3\|0\rangle-2i\|1\rangle$ Find its normalized state.	**8+7+5**	**CO5**
Q 11	a) What is Compton effect? Derive an expression for the Compton shift? b) Derive an expression for Schrodinger's time independent wave equation. **OR** a) Derive an expression for the energy of a particle trapped in a 1-D box. Find the zero point energy of this particle. b) State Heisenberg's uncertainty principle. Using the uncertainty principle, prove that the electron cannot exist inside the nucleus.	**10+10**	**CO4**

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule-sec
Rest mass of an Electron	9.11×10^{-31} Kg
Permittivity of free space (ε_0)	8.854×10^{-12} Farad/meter
Velocity of Light c	3×10^{8} m/sec
Charge of electron	1.6×10^{-19}C

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Course Code: PHYS1008 **Max. Marks: 100**

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SECTION A

S. No.		Marks	CO
Q 1	What is the cutoff wavelength of the optical fiber?	**4**	**CO1**
Q 2	Explain the following terms: (a) dielectric constant and (b) dielectric strength of a material.	**4**	**CO2**
Q 3	State Faraday's law and give its applications.	**4**	**CO3**
Q 4	Discuss the findings of the photoelectric effect's experimental setup?	**4**	**CO4**
Q 5	Show that the wavelength associated with the particle of mass 'm' and kinetic energy 'E' is given by $\lambda = \frac{h}{\sqrt{2mE}}$	**4**	**CO4**

SECTION B

Q 6	(a) A multimode step index optical fiber has core diameter 0.05 mm. Calculate the number of guided modes at operating wavelength 750 nm if numerical aperture is 0.25.	**5**	**CO1**
	(b) Explain key components of a lasing system.	**5**	
Q 7	Derive the expression for electric flux density due to a continuous finite line charge distribution using coulomb's law.	**10**	**CO2**
Q 8	What do you understand by phase velocity and group velocity of matter waves. Prove that $v_g = v_p - \lambda \frac{dv_p}{d\lambda}$	**10**	**CO4**
Q 9	Write the Maxwell's equations for time varying fields (final form). Discuss the	**10**	**CO3**

	contribution of Maxwell to modify the Ampere's law for non-steady fields. **OR** Using Ampere's law, derive magnetic field expression for infinite sheet of current.		
	SECTION-C		
Q 10	(a) Differentiate between Cbits and Qubits. (b) Suppose that $\{\|u_1\rangle, \|u_2\rangle, \|u_3\rangle\}$ is an orthogonal basis for a three dimensional Hilbert's space. A system is in the state given by $\|\psi\rangle = \frac{1}{\sqrt{5}}\|u_1\rangle - i\sqrt{\frac{7}{15}}\|u_2\rangle + \frac{1}{\sqrt{3}}\|u_3\rangle$ Determine if this state is normalized. (c) What do you understand by top-down and bottom-up approaches for the manufacturing of nanomaterials.	**5** **10** **5**	**CO5**
Q11	(a) Derive the time dependent Schrodinger Wave equation. (b) (i) An electron is confined in a 1D infinite potential box of boundary between 0 and 2 nm. If the particle has 6 nodes (excluding boundaries) find the particle energy in eV. (ii) An electron has a speed of 1.05×10^4 m/sec within the accuracy of 0.01%. Calculate the uncertainty in the position of the electron. **OR** (a) Show that the direction of the recoiled electron in Compton's effect is given by: $tan\varphi = \frac{\cot\frac{\theta}{2}}{1+\frac{h\nu}{m_0 c^2}}$ where θ is the scattering angle and φ represents the angle of recoiled electron. **(b)** (i) Calculate the lowest energy of an electron confined in a 3-D cubical box of each side 1Å. (ii) Find the temperature at which the average energy of the molecules of a perfect gas would be equal to the lowest energy of the electron, $k_B = 1.38\times10^{-23}$ J/K.	**10** **5** **5** **10** **10**	**CO4**

Values of constants:

Constant	Standard Values
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