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

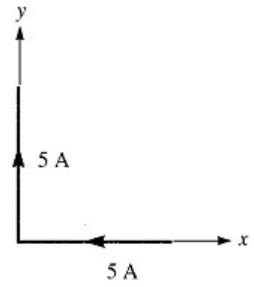
Program Name: B. Tech (SoCS) **Semester – I**
IOT, Block chain, OGI, OSS, CSF, Big Data, AI+ML, Devops
Course Name : Physics **Max. Marks :100**
Course Code : PHYS 1008 **Duration : 3Hrs**
No. of page/s: 02

All questions are compulsory.
Question numbers to be written very clearly.
All bold representations are vectors.

SECTION A (All Questions are compulsory)

1	Discuss characteristic properties of a LASER beam. How is it different from ordinary light beam?	**[4]**	**CO1**
2	The numerical aperture of a fiber is 0.25 and the fractional refractive index is 0.02. Determine the refractive indices of the core and cladding of a fiber	**[4]**	**CO1**
3	What do you understand by a wave function? Discuss the properties of a well-behaved wave function.	**[4]**	**CO4**
4	Given the ket $$\|\psi\rangle = 3\|0\rangle - 2i\,\|1\rangle$$ Find its normalized state.	**[4]**	**CO5**
5	Write the Maxwell's equations in differential and integral forms for static fields.	**[4]**	**CO2**

SECTION B
(All Questions are compulsory with an internal choice in Questions 10 and 11**)**

6	Discuss the working of He Ne LASER with the help of energy level diagram. Discuss all the processes involved.	**[8]**	**CO1**
7	Using Gauss's law, derive an expression for the electric flux density for an infinite sheet of charge.	**[8]**	**CO2**
8	An infinitely long conductor is bent into an L shape as shown in the figure below. If a direct current of 5 A flows in the conductor, find the magnetic field intensity at **(a)** (2, 2, 0), **(b)** (0, - 2, 0), and **(c)** (0, 0, 2). Take the origin at the bend. 	**[8]**	**CO3**
9	What do you understand by phase velocity (v_p) and group velocity (v_g) of matter waves. Prove that	**[8]**	**C04**

	$v_g = v_p - \lambda \frac{dv_p}{d\lambda}$		
10	What were the observations of photoelectric effect? Discuss how classical wave theory failed and how quantum theory of light was able to explain those observations.	**[8]**	**CO4**
	OR		
11	State Heisenberg's uncertainty principle and based on it explain why electron cannot exist inside the nucleus.	**[8]**	**CO4**
	SECTION C **(**All Questions are compulsory with an internal choice in Questions 13 and 14**)**		
12	(a) Using Ampere's law and continuity equation, obtain an expression for the displacement current density. (b) Differentiate between classical computing and quantum computing.	**[10]** **[10]**	**CO3** **CO5**
13	(a) Derive Schrodinger's wave equation in time independent form. Write the expression for Hamiltonian. (b) 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 = 1.38×10^{-23} J/K.	**[10]** **[10]**	**CO4** **CO4**
	OR		
14	(a) What is Compton Effect? Derive an expression for the Compton shift in wavelength by considering inelastic scattering of a photon with an electron. (b) 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 $h = \frac{(E_2-E_1)\lambda_1\lambda_2}{C(\lambda_1-\lambda_2)}$ and $\varphi = \frac{E_2\lambda_2-E_1\lambda_1}{(\lambda_1-\lambda_2)}$	**[10]** **[10]**	**CO4** **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