Name:

Enrolment No:

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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, June 2021

Course:Engineering Physics **Semester: II**
Program: B.Tech. : SOCS (Batches 21-40) **Time: 03 Hrs**
Course Code: PHYS 1023 **Max. Marks: 100**

SECTION A

1. **Each Question carries 5 Marks**
2. **Instruction: Complete the statement / Select the correct answer(s)/ Write short answers/ Solve**

S. No.	Question	Marks	CO
Q 1	(a) The pumping mechanism used in a Ruby laser is …….. (b) The refractive index of the core is …… than that of the cladding. (c) A hologram contains the information of the object in both …… and ……. (d) A hologram is the result of interference of …….and ……beams. (e) The hologram acts as a ……in the reconstruction process.	**5**	**CO1**
Q 2	A graded-index fiber has a core diameter of 0.25 mm and a numerical aperture of 0.22 at a wavelength of 8000 Å. Find the normalised frequency. (mention the value to the nearest second decimal)	**5**	**CO1**
Q 3	The surfaces $\rho = 2, \phi = 100°, z = 3$ and $\rho = 7, \phi = 130°, z = 4.5$ define a closed surface. Find the enclosed volume. (mention the value to the nearest second decimal)	**5**	**CO2**
Q 4	Write the statements for (a) Faraday's law (b) Ampere's Law	**5**	**CO3**
Q 5	Select all that apply in the case of matter waves. (a) Matter waves are Independent of charge type (b) Matter waves are neither electromagnetic waves nor acoustic waves (c) Lighter is the particle, lower is the wavelength (d) The velocity of matter waves is greater than the velocity of light (e) The matter waves exhibit a diffraction pattern. (f) Smaller is the velocity of the particle, smaller is the wavelength (g) Do not require any material medium for their propagation	**5**	**CO4**
Q 6	A "Qubit" can be Implemented by [Select all that apply] (a) photoionization of photon (b) polarization of photon (c) the energy level of the neutron (d) the Energy level of an atom (e) rotation of an electron (f) spin orientation of an electron	**5**	**CO5**

SECTION B

1. **Each question carries 10 Marks**
2. **Instruction: Write short/ brief notes/ Derive/ Solve**
3. **All bold representations are vectors.**

Q 7	(a) Distinguish between spontaneous and stimulated emissions. (b) What is numerical aperture? Derive an expression for numerical aperture in terms of relative refractive index.	**5** **5**	**CO1**
Q 8	(a) State and explain Gauss's law in electrostatics in its integral and differential forms. (b) Apply Gauss's law to determine the electric field due to a surface charge with surface charge density, ρ_s C/m^2.	**5** **5**	**CO2**
Q 9	(a) Obtain an expression for transformer EMF. (b) In a certain conducting region, $\boldsymbol{H} = yz(x^2 + y^2)\boldsymbol{a_x} - y^2xz\boldsymbol{a_y} + 4x^2y^2\boldsymbol{a_z}$ A/m, Determine $\boldsymbol{J}$ at $(5, 2, -3)$	**4** **6**	**CO3**
Q 10	(a) Calculate the de-Broglie wavelength associated with a proton moving with a velocity equal to $(1/20)^{th}$ the velocity of light. (b) Apply Heisenberg's uncertainty principle to explain the non-existence of electrons within the nucleus.	**5** **5**	**CO4**
Q 11	(a) Distinguish between a classical computer and quantum computer (any four points) (b) Given $\|\psi\rangle = 3\|0\rangle - 2i\,\|1\rangle$ Find its normalized state.	**4** **6**	**CO5**

SECTION C

1. **Each Question carries 20 Marks.**
2. **Instruction: Write long answer/ Derive/ Solve**

Q 12	(a) 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 up to a maximum value E_2. Prove that Planck'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**	**CO4**
	(b) X-rays with $\lambda = 1$Å are scattered from a carbon block. The scattered radiation is viewed at 90° to the incident beam. i. What is the Compton shift in the wavelength? ii. What kinetic energy is imparted to the recoil electron?	**10**	
	OR		
	(c) Derive Schrodinger's wave equation in time-independent form. Write the expression for Hamiltonian.	**10**	
	(d) The wavefunction of a certain particle is, $\psi = A\cos^2 x$ for $-\frac{\pi}{2} < x < \frac{\pi}{2}$ i. Find the value of A ii. Find the probability that the particle be found between $x = 0$ and $x = \frac{\pi}{2}$	**10**	

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule $-$ sec
permittivity of free space (ε_0)	8.85×10^{-12} Farad/meter
velocity of light (c)	3×10^{8} m/sec
Boltzmann constant (k_B)	1.38×10^{-23} JK^{-1}
rest mass of an Electron	9.11×10^{-31} Kg
mass of the proton	1.67×10^{-27}Kg
charge of an electron	1.6×10^{-19} C