Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, Dec 2022

Course: Physics **Semester : I**

Program: B.Tech. Biomedical Eng. (SOHST) **Time : 03 hrs.**

Course Code: PHYS 1021 **Max. Marks: 100**

Instructions:

- All questions are compulsory (**Q. No. 26** and **Q. No. 28** has an internal choice)
- All **highlighted** representations are **vector quantities**.
- Scientific calculators can be used for calculations.

SECTION A

$(\mathbf{20Q \times 1.5M = 30\ Marks})$

- All questions are compulsory, Each Question carries **1.5 Marks**
- Write very Short Answers/ Solve

Q. No.	Statement of question	Marks	CO
Q 1.	Mention the process under which an electron jumps from higher energy state to lower energy state by the influence of incident photon (a) induced emission (b) spontaneous emission (c) simple emission (d) none of these.	**1.5**	**CO1**
Q 2.	The output beam in ruby laser is (a) continuous (b) discontinuous (c) both (a) & (b) (d) none of these	**1.5**	**CO1**
Q 3.	The method of population inversion to the laser action in He–Ne laser is: (a) molecular collision (b) direction conversion (c) electric discharge (d) electron impact	**1.5**	**CO1**
Q 4.	Optical fibre communication is based on the phenomenon of (a) refraction (b) total internal reflection (c) polarisation (d) diffraction	**1.5**	**CO1**
Q 5.	The inner most part of the optical fibre in known as (a) core (b) cladding (c) sheath (d) optical fibre axis.	**1.5**	**CO1**
Q 6.	In graded index optical fibre the refractive index of core is (a) non-uniform (b) increase towards the axis of core (c) same at core-cladding interface (d) all of these.	**1.5**	**CO1**
Q 7.	A vector field $(\vec{A})$ will be conservative and irrotational when (i) $\vec{\nabla} \cdot \vec{A} = 0$ (ii) $\vec{\nabla} \times \vec{A} = 0$ (iii) none of these (iv) both (a) and (b)	**1.5**	**CO2**
Q 8.	Write down the expression for Gauss's divergence theorem.	**1.5**	**CO2**
Q 9.	What is the origin of displacement current?	**1.5**	**CO2**
Q 10.	The unit of electric flux in SI system of units is (a) Weber (b) Gauss (c) Nm^2/C (d) N / C	**1.5**	**CO2**

Q 11.	Following expression represents the wave motion (a) $E = E_0 \sin wt$ (b) $E = E_0 \sin (wt – kx)$ (c) $E= E_0 \cos kx$ (d) $E = E_0 \sin \cos wt$	**1.5**	**CO3**
Q 12.	The work done in displacing a charge 2C through 0.5 m on an equipotential surface is (a) zero (b) 4 J (c) 1 J (d) none of these	**1.5**	**CO3**
Q 13.	In EM wave (a) electrons produce magnetic field only (b) electron produce electric field only (c) time variation of electric field produces magnetic field and vice-versa (d) time variation of electric field guides the wave	**1.5**	**CO3**
Q 14.	The group velocity of matter waves is (a) equal to the particle velocity (b) greater than the particle velocity (c) less than the particle velocity (d) same as phase velocity	**1.5**	**CO4**
Q 15.	Quantum theory successfully explains the phenomena of (a) photoelectric and compton effects (b) interference, diffraction and polarisation (c) black body radiations (d) all of these	**1.5**	**CO4**
Q 16.	Matter waves (a) show diffraction (b) show interference (c) polarisation (d) none of these	**1.5**	**CO4**
Q 17.	Heisenberg uncertainty relation holds good for (a) microscopic as well as macroscopic particles both (b) only microscopic particles (c) only macroscopic particles (d) none of these	**1.5**	**CO4**
Q 18.	The momentum of a particle in infinite potential well is (a) proportional to n (b) inversely proportional to n^2 (c) proportional to n^2 (d) inversely proportional to n	**1.5**	**CO4**
Q 19.	The entire information of a quantum system can be gathered with the help of (a) position (b) eigen value (c) momentum operator (d) wave function	**1.5**	**CO4**
Q 20.	A “QUBIT” can be Implemented by [choose all that apply] a) Photonisation of photon b) polarization of photon c) The energy level of the neutron d) The Energy level of an atom	**1.5**	**CO5**

SECTION B

$(\mathbf{4Q \times 5M = 20\ Marks})$

- All questions are compulsory. Each Question carries **5 Marks**
- Write very Short Answers/ Solve

Q 21.	Show that the wavelength λ associated with a particle of mass m and kinetic energy E is given by; $\lambda = \frac{h}{\sqrt{2mE}}$ where h=Planck’s constant	**5**	**CO4**

Q 22.	Outline Maxwell's equations in differential and integral forms for time dependent fields.	**5**	**CO2**
Q 23.	Explain Ampere's Circuital law with proper diagram.	**5**	**CO3**
Q 24.	The Optical power of 0.5 mW is initially launched into an optical fiber. The power level is found to be 0.0199 mW after 4 km. Calculate the attenuation coefficient.	**5**	**CO1**
SECTION C $(\mathbf{2Q} \times \mathbf{15M} = \mathbf{30}\ \mathbf{Marks})$ • All questions are compulsory, **Q 26.** has an internal choice, Each Question carries **15 Marks** • Write long answer/ Derive/ Solve			
Q 25.	**(a)** Define Electric potential and write the relation between electric potential and electric field intensity. Show that the Electrostatic field is a conservative field. **(10)** **(b)** A region is specified by a potential function given by: $\phi = 4x^2 + 3y^2 - 9z^2$. Calculate electric field strength at a point (3, 4, 5) in this region. **(5)**	**15**	**CO2**
Q 26.	**(a)** Derive time independent Schrodinger wave equation. **(10)** **(b)** Calculate the lowest energy of an electron confined in a 1-D cubical box of each side 2 Å. **(5)** **OR** **(a)** Explain Einstein's equation for photoelectric effect with proper explanation. **(5)** **(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 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)**	**15**	**CO4**
SECTION-D $(\mathbf{2Q} \times \mathbf{10M} = \mathbf{20}\ \mathbf{Marks})$ • All questions are compulsory, **Q.No. 28** has an internal choice, Each Question carries **10 Marks** • Write long answer/ Derive/ Solve			
Q 27.	**(a)** Mention any four differences between a classical computer and quantum computer. **(4)** Given $\lvert\psi\rangle = 6\lvert 0\rangle - 5i\,\lvert 1\rangle$. Find its normalized state. **(6)**	**10**	**CO5**
Q 28.	Describe the construction and working of a He-Ne laser system with proper diagram and labelling the components used. **(10)** **OR** Discuss different types of optical fiber with the refractive index profiles. **(10)**	**10**	**CO1**

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 (m_o)	9.11×10^{-31} kg
Mass of the proton (m_p)	1.67×10^{-27}kg
Charge of an electron (e)	1.6×10^{-19} C