**Registration No.:**

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**Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.**
**The figures in the right hand margin indicate marks.**

**Part-I**

**Q1** **Answer the following questions:** **(2 x 10)**

**a)** What are free and forced oscillations?

**b)** If a particle executes a simple harmonic motion of period 8 s and amplitude 0.40 m, find the maximum velocity and acceleration.

**c)** Define Interference of waves. Write the types of Interference.

**d)** When monochromatic light is incident on a slit of width 0.022 mm, the first diffraction minimum is observed at an angle of $1.8^o$ from direction of incident light. Find out $\lambda$.

**e)** A silica glass optical fibre has a core refractive index of 1.500 and the cladding refractive index of 1.450. Calculate critical angle for core-cladding interface and numerical aperture (NA) of the fibre.

**f)** What is the difference between Crystalline and Amorphous Solid?

**g)** State Gauss law in electrostatic field. Write its integral and differential form.

**h)** What is the physical significance of curl of a vector field?

**i)** What is pair production?

**j)** What is Compton effect? Write expression for Compton shift.

**Part-II**

**Q2** **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 × 8)**

**a)** Starting from the differential equation of a damped oscillator, write the solution for under damped oscillatory motion. Graphically show the variation of amplitude with time. Mention the condition for critical damping.

**b)** Two simple pendulum of mass m and length l each are coupled by a spring of force constant k. Write the expression for frequency of normal modes of vibration of the coupled system.

**c)** What is a zone plate? Mention the similarities and difference between a converging lens and a zone plate.

**d)** What is a Bi-prism? How can the wavelength of monochromatic light be measured with the help of a Fresnel's Bi-prism.

**e)** Show that the radii of Fresnel half period zones are proportional to the square root of nature numbers.

**f)** Write about the basic characteristics of optical fiber and its application incommunication system.

**g)** What do you mean by energy band gap? Classify metals, semiconductor, and insulators in terms of band theory.

**h)** Prove that the curl of gradient of a scalar field is zero and divergence of curl of a vector field is zero.

**i)** Derive a relation between magnitudes of electric vector and magnetic vector.

**j)** What do you mean by Photoelectric effect? Discuss Einstein's photoelectric equation. Define Stopping potential.

**k)** What is uncertainty principle?Using uncertainty principle, show the non-existence of electron inside the nucleus.

**l)** If the wavefunction of a moving particle $\psi = A \sin(\pi x/L)$ is normalized in $0 < x < L$, find the value of normalization constant then write the normalized wavefunction.

## Part-III
### Only Long Answer Type Questions (Answer Any Two out of Four)

**Q3 a)** Set up the differential equation for a forced oscillator. Solve it to obtain the displacement x(t) of vibrating particle. **(6)**

**b)** Give the theory of Newton's ring. Explain how the wavelength of monochromatic light and refractive index of liquid is determined using Newton's ring arrangement. **(10)**

**Q4 a)** With a suitable diagram explain the construction and working of He-Ne laser. What are the advantages and limitations of a He-Ne Laser? **(12)**

**b)** Explain Bragg's law of X-ray diffraction. State its significance. **(4)**

**Q5 a)** State Maxwell's equations in differential and integral forms both in presence and absence of free charge and currents. Discuss the significance of each Maxwell equation. **(10)**

**b)** Show that electromagnetic waves are transverse in nature. **(6)**

**Q6 a)** Starting from the Schrodinger's equation for a particle confined in a one dimensional box of infinite height, develop an expression for the normalized wave function. Show that its energy is discrete and quantized. **(12)**

**b)** What are matter waves? If the ratio of the velocities of proton and α-particle is 8:1; then find the ratio of their de-Broglie wavelengths. **(4)**