Total number of printed pages:3 **UG/1st/UPH101**

2021

ENGINEERING PHYSICS

Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. [8+6+6]

(a)Set up the differential equation for forced harmonic oscillation and find its steady state solution.

(b) The under damped solution for loaded spring is represented by, $x=A_0e^{-0.5t}\cos(628t+\varphi)$, where the symbols have their usual meaning. Determine the value of amplitude relaxation time, logarithmic decrement and quality factor of the oscillator.

(c)What is interference? Explain different types of interference.

2. [8+4+8]

(a)Describe the experimental set up for Newton's ring apparatus and derive an expression for diameter of the n^{th} dark ring for reflected light.

(b) In a certain Newton's ring setup the wavelength for monochromatic light is 5.9×10^{-5} cm. If radius of curvature for plano-convex lens is given by 100 cm then find the diameter of 5^{th} dark and 10^{th} bright ring.

(c)In single slit diffraction the amplitude at a point is given by, $R = A_0 \frac{\sin\alpha}{\alpha}$, where symbols have their usual meaning. Discuss as well as derive the expression for minima, maxima and secondary maxima condition with intensity distribution curve.

3. [2+1+3+5+5+4]

(a) Define Electric Flux.

(b)Write the unit of Electric Flux.

(c) A charge q is placed at the centre of a cube of side L. What is the electric flux passing through each face of the cube?

(d) There are three charges q_1, q_2, and q_3 having charge 10 C, 20 C and 5 C enclosed in a surface. Find the total flux enclosed by the surface. ($\epsilon_0 = 8.854\times10^{-12}$ F/m)

(e) State Gauss' law in electrostatics.

(f) Using Gauss' law, derive an expression for the electric field due to a uniformly charged infinite plane Sheet.

4. [5+5+5+5]

(a) Explain Poisson's equation and Laplace equation.

(b) Derive Ampere's Law from Biot-Savart Law.

(c) Find the relation between Einstein Coefficients A and B of LASER radiations.

(d) In a LASER unit, LASER beam of wavelength $6328A^0$ is emitted. How many photons are released per unit second if the output power is 1mW?

5. [10+6+4]

(a) Obtain the expressions for energy, wave function and probability density of a particle trapped in an one dimensional potential box of infinite potential wall and explain the concept of zero point energy.

(b) State and explain Stokes' theorem.

(c) Obtain the value of the divergence of position vector $\vec{r}$

6. [5+6+9]

(a) State and explain Heisenberg's uncertainty relation.

(b) Compare and contrast between heat and work.

(c) Compute div$\vec{F}$ and curl$\vec{F}$ for $\vec{F} = x^2y\hat{i} - (z^3 - 3x)\hat{j} + 4y^2\hat{k}$

7. [6+5+5+4]

(a) A monochromatic beam of wavelength 5893Å incident on the plane of the slit having width 2×10^{-4} cm. If distance separation between screen and slit is 100 cm find angular and linear width of the central maxima.

(b) Write short notes on Ruby LASER.

(c) Explain the working principle of Carnot's engine.

(d) A Carnot engine has an efficiency of 0.60 and the temperature of its cold reservoir is 300 K. (i) What is the temperature of the hot reservoir? (ii) If the engine does 300 J of work per cycle, how much heat is removed from the high-temperature reservoir per cycle? (iii) How much heat is exhausted to the low-temperature reservoir per cycle?