

B. INFORMATION 1ST. YEAR 1ST. SEM. EXAM. (Old) – 2019

PHYSICS – IA

Time: 3 hours

Full Marks: 100

Answer any five questions.

1. a) Write down the differential equation for a wave motion.
 b) What do mean by interference of light?
 c) Distinguish different classes of diffraction.
 d) Find the intensity distribution for a single slit diffraction experiment.
 e) Derive the radius of n -th dark ring in Newton ring experiment.
2. a) Define phase velocity and group velocity.
 b) Write down the equation of motion of a simple harmonic oscillator with and without damping force.
 c) Solve the equation of damped oscillation and draw x vs. t diagram for all cases.
3. a) Write down Gauss's law in electrostatics.
 b) What do you mean by resonance in series LCR circuit? Find an expression for the Q factor for the above circuit.
 c) Derive an expression for capacitance of a cylindrical capacitor with inner radius a and outer radius b and having surface charge density σ .
 d) What is the electrostatic energy stored in a parallel plate capacitor?
 e) Write Ampere's circuital law.
4. a) Define conservative force field. Give two examples.
 b) What do you mean by gradient of a scalar function? Evaluate the gradient on the surface $yz - xyz^2 = -8$ at $(1,2,2)$.
 c) Prove $\vec{\nabla} \cdot (f\vec{A}) = (\vec{\nabla}f) \cdot \vec{A} + f\vec{\nabla} \cdot \vec{A}$
 d) Calculate $\vec{\nabla} \left(\frac{1}{r} \right)$.
5. a) State and explain briefly the first law of thermodynamics.
 b) Show that the total internal energy of the universe is constant.
 c) Write down zeroth of thermodynamics?
 d) What do you mean by state function of a system? Write and explain all the statements of the second law of thermodynamics.
 e) What do you mean by entropy of a system?

- f) Show diagrammatically the different steps of a Carnot engine and Carnot refrigerator. Then define efficiency of a Carnot engine in terms heat energy from the Carnot cycle.
6. a) Write down the Schrodinger equation. When the probability density of the state is not function of time? Show this starting from the Schrodinger equation.
- b) Find the wave function and energy eigen values of the particle confined under the potential $V(x) = 0$ for $0 < x < a$, and elsewhere $V(x) = \infty$.
- c) Plot i) wave function, and ii) probability density as a function of x .
7. a) Calculate the de Broglie wavelengths of an electron having kinetic energy 13.6 eV and an iron ball having mass 10 gm and velocity 10 m/s.
- b) Prove that $[\hat{x}, \hat{p}] = i\hbar$.
- c) Write down, de Broglie hypothesis.
- d) Write down the postulates of quantum mechanics.