

2021-22

ENGINEERING PHYSICS

PHC01

Time – 2 hours

Full Marks –60

Part – B

Answer any SIX questions.

6 x 5 = 30 (**Time: 1hr. 15 Mins.**)

1. (a) Two perpendicular SHMs having same time period but different amplitudes and initial phases act simultaneously on a particle. Under what condition, the resultant motion will be left-handed elliptically polarized vibration.
(b) Show that the ratio of two successive amplitudes of a damped harmonic oscillation is constant and hence define logarithmic decrement of oscillation. (2.5+2.5)
2. (a) For a forced oscillator, show that the angular frequency width of the power resonance curve at half maximum power is inversely proportional to the mean decay time of free damped oscillations.
(b) “Smaller the damping, sharper is the resonance”. Justify with equation and plot. (3+2)
3. (a) Derive classical wave equation and state its main inferences.
(b) Starting from Maxwell’s equations in free space show that the magnetic field \vec{H} and electric field \vec{E} in an electromagnetic wave travel with the velocity of light. (2+3)
4. (a) What is ultraviolet catastrophe? How did Planck explain it with the help of Planck’s oscillators?
(b) State and explain Heisenberg’s uncertainty principle (both for energy and momentum). ((1+2)+2)
5. Solve the Schroedinger wave equation for a particle moving in a one-dimensional potential box. Show that the eigenvalues of energy and momentum are discrete. (3+2)
6. (a) With a schematic diagram explain Young’s double slit interference experiment. Hence, derive the expression for fringe width by assuming the plane of the slits and plane of the screen are parallel to each other
(b) Two plane glass surfaces in contact along one edge are separated at the opposite edge by a thin wire. If 20 interference fringes are observed between these edges in sodium light ($\lambda=589.0$ nm) of normal incidence, what is the thickness of the wire? (2+1+2)

7. Derive an expression for the intensity distribution for Fraunhofer diffraction at plane diffraction grating. Plot the corresponding intensity distribution curve. (4+1)
8. (a) Write and explain Brewster's law. A near monochromatic light is travelling in water ($n_1 = 1.33$) and then it is incident on a glass plate ($n_2 = 1.5$). Calculate the angle of incidence for which the reflected light will be completely linearly polarized?
- (b) What do you understand by the phenomenon of double refraction? Give two examples of double refracting crystals. (2+1+2)
9. (a) What is an Optical fibre? Explain the mechanism of propagation of light within an optical fibre and write the significance of the angular acceptance cone.
- (b) Plot the refractive index profile of the step index (SI) fibre
- (c) Refractive index of the core of an optical fibre is 1.50 and that of cladding is 1.48. Find the numerical aperture (NA) of the fibre. (3+ 1 + 1)
10. Write the principle of operation of the He-Ne Laser with the help of necessary energy level diagram. (5)