ENTRI

APJ Abdul Kalam Technological University

First Semester B.Tech Degree Examination December 2019

(2019 Scheme)

- **Course Code:** PHT110
- **Course Name:** Engineering Physics B
- **Max. Marks:** 100
- **Duration:** 3 Hours

PART A

Answer all questions, each carries 3 marks.

1. Derive the differential equation of a damped harmonic oscillator.
2. Find the equation of a progressive wave of amplitude 2 cm, frequency 50 Hz, and velocity 20 cm/s moving along the positive x-axis.
3. How will you test the planeness of a surface using an air wedge?
4. Distinguish between Fresnel and Fraunhofer classes of diffraction.
5. What is de Broglie hypothesis of matter waves? Write the equation of de Broglie wavelength.
6. Give three medical applications of nanotechnology.
7. What is meant by intensity of sound? Give the equation connecting intensity and amplitude.
8. What are ultrasonic waves? Mention any four properties of them.
9. What is an optical resonator? Explain its role in laser emission.

10. Discuss the advantages of optical fibre over conventional transmission lines.

PART B

Answer one full question from each module, each question carries 14 marks.

Module-I

11. a) Define the terms: resonance, logarithmic decrement, and sharpness of resonance. Derive the expression for the amplitude of a forced harmonic oscillator. (10 marks)
b) A damped harmonic oscillator has a mass of 0.2 kg, a spring constant of 20 N/m, and a damping constant of 0.5 kg/s. Calculate the period of oscillation. (4 marks)
OR
12. a) Explain the production of transverse waves in a stretched string. Derive the expression for the fundamental frequency and the first two overtones. (10 marks)
b) A string of length 2 m and mass 0.04 kg is stretched with a tension of 80 N. Find the frequency of the fundamental note. (4 marks)

Module-II

13. a) Explain the theory of interference by division of amplitude. Derive the conditions for constructive and destructive interference in thin films due to reflected light. (10 marks)
b) A soap film of refractive index 1.33 is illuminated by light of wavelength 589 nm. Find the minimum thickness for the film to appear bright. (4 marks)
OR

14. a) What is a plane transmission grating? Derive the grating equation. Explain how the wavelength of light is determined using a grating. (10 marks)
b) Light of wavelength 500 nm is incident normally on a grating with 5000 lines/cm. Find the angle of diffraction for the second-order maximum. (4 marks)

Module-III

15. a) Derive the time-independent Schrödinger equation for a particle moving in a one-dimensional potential. (10 marks)
b) Find the energy of an electron in the first excited state in a 1D box of width 1 Å. (4 marks)

OR

16. a) Explain the effect of size on the mechanical, optical, and electrical properties of nanomaterials. (10 marks)
b) Discuss quantum mechanical tunnelling and give two examples. (4 marks)

Module-IV

17. a) Explain any six factors affecting acoustics of a hall and give their remedial measures. (9 marks)
b) An auditorium has dimensions 45m x 10m x 8m. The average absorption coefficients of the wall, ceiling, and floor are 0.8, 0.4, and 0.5 respectively. Evaluate the reverberation time of the hall. (5 marks)

OR

18. a) What is the inverse piezoelectric effect? How are ultrasonic waves detected using the piezoelectric effect? What is NDT? Explain any one NDT method. (10 marks)
b) Calculate the fundamental frequency of vibration of a quartz crystal of thickness 8 mm at resonance if its

Young's modulus is $Y = 7.9 \times 10^{10}\ N/m^2$ and density is $2650\ kg/m^3$. (4 marks)

Module-V

19. a) Explain the construction and working of a ruby laser with schematic and energy level diagrams. (10 marks)

b) What are Einstein's coefficients? Give their significance in lasing action. (4 marks)

None

OR

20. a) Explain the propagation of light through an optical fibre and derive the expression for Numerical Aperture. (10 marks)

b) A step-index fibre has a core refractive index of 1.5 and a cladding refractive index of 1.48. Calculate its acceptance angle and numerical aperture. (4 marks)

None