ENTRI

# APJ Abdul Kalam Technological University

## First Semester B.Tech Degree Examination December 2021

## (2019 Scheme)

- **Course Code:** PHT100
- **Course Name:** Engineering Physics A
- Max. Marks: 100
- **Duration:** 3 Hours

---

**PART A**

**Answer all questions, each carries 3 marks.**

1. What is Q-factor? How is it related to angular frequency?
2. Calculate the frequency of the fundamental note produced by a string 1m long and weighing 2gm kept stretched by a load of 400kg.
3. Why does the central fringe of Newton's ring appear dark?
4. What is meant by dispersive power of grating? Give the expression with relevant terms.
5. Estimate the uncertainty in the frequency of light emitted by an atom.
6. Describe the significance of large surface area to volume ratio of nano materials.
7. State Gauss' law in magnetism. Write the mathematical statement.
8. Define divergence of a vector field. Establish its physical significance.
9. What are Cooper pairs? What is their role in superconductivity?
10. What is a photo detector? Give two examples.

---

**PART B**

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

**Module-I**

11. a) Define the terms transverse vibrations, fundamental frequency and overtones. Derive the expression for the fundamental frequency of a stretched string. (10 marks)

b) A string of length 0.5 m has a mass of 0.01 kg. If it is stretched by a force of 100 N, calculate the frequency of the fundamental note and the first two overtones. (4 marks)

**OR**

12. a) What are ultrasonic waves? Explain how ultrasonic waves are produced using a magnetostriction oscillator with a neat circuit diagram. (10 marks)

b) Calculate the capacitance of a capacitor required to produce ultrasonic waves of frequency 1 MHz with an inductor of inductance 1 mH. (4 marks)

None

# Module-II

13. a) Explain the theory of interference in thin films due to reflected light and derive the conditions for constructive and destructive interference. (10 marks)

b) A thin film of refractive index 1.5 is illuminated by light of wavelength 600 nm. Calculate the minimum thickness

of the film for it to appear dark in reflected light. (4 marks)

**OR**

14. a) What is meant by diffraction? Explain the Fraunhofer diffraction at a single slit and obtain the conditions for the positions of principal maximum and minima. (10 marks)

b) A light of wavelength 589.3 nm is incident normally on a slit of width 0.1 mm. Find the angular width of the central maximum. (4 marks)

## Module-III

15. a) State and explain the Heisenberg Uncertainty Principle. Use it to prove that electrons cannot exist inside the nucleus. (10 marks)

b) An electron is confined to move in a one-dimensional box of width 1 Å. Calculate its minimum energy in eV. (4 marks)

**OR**

16. a) Explain the effect of size on mechanical, optical and electrical properties of nanomaterials. Mention any four applications of nanotechnology. (10 marks)

b) Explain Quantum confinement. (4 marks)

## Module-IV

17. a) Define the terms magnetisation, magnetic flux density, magnetic permeability, relative permeability and susceptibility. Obtain the relation between relative permeability and susceptibility. (10 marks)

b) Calculate the magnetic flux density and the magnetic moment per unit volume when a magnetising field of $6 \times 10^5$ A/m is applied. Magnetic susceptibility is $-8.2 \times 10^{-6}$. (4 marks)

**OR**

18. a) Derive Maxwell's equations from the fundamental laws of electricity and magnetism. (10 marks)

b) A plane electromagnetic wave (sinusoidal) has a maximum intensity of electric field $200 \times 10^{-6}$ V/m. Calculate $H_{max}$. (4 marks)

## Module-V

19. a) Describe the phenomenon of superconductivity. Define critical temperature and critical magnetic field. Mention any four applications of superconductors. (8 marks)

b) Distinguish between Type I and Type II superconductors. (6 marks)

**OR**

20. a) Define acceptance angle and numerical aperture of an optic fibre. Derive an expression for the numerical aperture of a step-index fibre. (10 marks)

b) The numerical aperture of an optic fibre is 0.5075 and the refractive index of the cladding is 1.475. Calculate the refractive index of the core, acceptance angle, and the critical angle for total internal reflection. (4 marks)