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SAINTGITS COLLEGE OF ENGINEERING, KOTTAYAM, KERALA
(AN AUTONOMOUS COLLEGE AFFILIATED TO
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER B.TECH DEGREE EXAMINATION (S, FE), NOVEMBER 2024

Course Code: 20PHT110

Course Name: ENGINEERING PHYSICS B

Max. Marks: 100   **Duration: 3 Hours**

PART A
(Answer all questions. Each question carries 3 marks)

1. Define Quality factor of a damped harmonic oscillator. If the frequency of a tuning fork is 256 Hz and its Q factor is 1000, find the relaxation time.

2. Distinguish transverse and longitudinal waves with example.

3. Why thin films exhibit colours when viewed with white light?

4. Explain briefly Rayleigh criterion for resolving power of an optical instrument.

5. What is Quantum Mechanical Tunneling?

6. Why do nanomaterials exhibit properties different from bulk materials?

7. Distinguish musical sound and noise. Give the values of threshold of hearing and threshold of pain intensities.

8. Explain the thermal and piezoelectric detection methods of ultrasonic waves.

9. What are the characteristics of a laser beam?

10. Distinguish step index and graded index fibers.

PART B
(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the different cases with graphs.   (10)

    b) Compare electrical and mechanical oscillators.   (4)

OR

12. a) Derive an expression for the velocity and frequency of transverse waves in a stretched uniform string.   (10)

    b) The displacement of a transverse wave is given by $y(x,t) = 2sin(\frac{2\pi}{6}x - 40\pi t)$, where x is measured in meters and t in seconds. Evaluate the wavelength, frequency and velocity of the wave.   (4)

MODULE II

13. a) Explain the experimental setup for forming Newton's Rings. Derive the expression for radius of the nth dark ring.   (10)

b) An air wedge is formed using two glass plates of length 82 mm, separated at one end by a wire of diameter 0.042 mm. What will be the bandwidth of the fringes, if the wedge is viewed in sodium light of wavelength 5890 Å. (4)

OR

14. a) What is a plane transmission grating? Explain the diffraction in a plane transmission grating. Obtain the grating equation. (10)

b) Distinguish interference and diffraction of light. (4)

MODULE III

15. a) State Heisenberg's uncertainty principle. Write its mathematical form for the following pairs of variables (i) position and momentum (ii) energy and time (iii) angular position and angular momentum. How this principle can be used to prove the absence of electrons inside the nucleus of an atom. (10)

b) An electron is bound to move in a one-dimensional box of width 10 Å. Calculate the separation between the two lowest energy levels in electron volt.
(m_e = 9.1×10^{-31} Kg, 1eV = 1.6×10^{-19} J). (4)

OR

16. a) Explain surface to volume ratio for nanomaterials. Define quantum confinement. Classify and explain nanostructures based on the number of dimensions which are confined. (10)

b) Explain any four applications of nanomaterials. (4)

MODULE IV

17. a) Define reverberation. Describe the acoustic qualities of a hall and its remedies. (10)

b) Calculate the reverberation time of a hall having a volume 5000 m^3 and total sound absorption of 180 Sabine. Find the additional sound absorption required for an optimum reverberation of 1.8 s. (4)

OR

18. a) Define magnetostriction effect. With a neat diagram, explain how ultrasonic waves are produced by a magnetostriction oscillator. (10)

b) Calculate the thickness of quartz crystal required to produce ultrasonic waves of frequency 1 MHz. Young's modulus and density of quartz are 8×10^{10} N/m^2 and 2650 Kg/m^3. (4)

MODULE V

19. a) Construct a He-Ne laser and explain the working with an energy level diagram. (10)

b) What is the advantage of holography over photography. (4)

OR

20. a) Explain how light is propagated in a step index fiber. Derive the expression for numerical aperture of a step index fiber with neat diagram. (10)

b) The refractive index of core and cladding of a fiber are 1.45 and 1.42 respectively. Find the numerical aperture and acceptance angle of the fiber. (4)

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