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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

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

Common for Civil Engineering & Mechanical Engineering,

(2024 SCHEME)

Course Code : 24BSE1002-A

Course Name : Engineering Physics

Max. Marks : 50 **Duration: 2.5 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Distinguish transverse and longitudinal waves with one example each.
2. Why oil films and soap films show different colours in sunlight?
3. What is photoelectric effect? Explain the importance of frequency in photoelectric effect.
4. Explain how ultrasonics waves are detected by piezoelectric method?
5. What are the three requisites for laser action to take place?

PART B

(Answer one full question from each module, each question carries 7 marks)

MODULE I

6. a) Graphically show under damped and overdamped motions. Discuss one practical real-world application of each damping case. 4
   b) For a forced harmonic oscillator with an amplitude of 0.01 mm at low frequency and 4 mm at 200 Hz, determine: (1) Q-factor (2) Damping constant (3) Relaxation time. 3

OR

7. a) What are the forces acting on a forced harmonic oscillator? Derive the equation for Quality factor at resonance. 4
   b) A wave travels along a 350 m wire that has a mass of 18 kg and a wavelength of 35 cm. Given that the wire is under a tension of 1.2 kN, determine the wave's speed and frequency. 7

MODULE II

8. a) Derive the grating equation. 4
   b) The radius of curvature of the convex surface of a plano convex lens is 120 cm. The lens is placed convex side down on a plane glass plate, and illuminated from above with red light of wavelength 650 nm. Find the diameter of the second dark ring in the interference pattern. 3

OR

9. a) Show that the minimum thickness of the film used in antireflection coatings depends on refractive index of the film. 4
   b) A diffraction grating have 5905 lines per cm is illuminated normally by light of wavelength 5893 Å. Calculate its dispersive power in second order spectrum. 3

MODULE III

10. a) Assuming the time-independent Schrödinger wave equation, derive the energy eigen value for a particle in a one-dimensional potential well of infinite height. 4

b) Calculate the separation between the two lowest energy levels of an electron in a one dimensional box of width 4 Å. Given mass of electron is 9.1×10^{-31} Kg and $h = 6.6 \times 10^{-34}$ Js. 3

OR

11. a) What are quantum mechanical operators? How do you use an operator to find the eigen value of an observable? Give two examples for quantum mechanical operators. 4

b) Find the uncertainty in the velocity of a particle whose uncertainty in position is 10^{-10} m. The mass of the particle is 10^{-27} Kg. 3

MODULE IV

12. a) Explain how reverberation, sound focussing, loudness, and echo impact the acoustics of an auditorium. What remedial measures can be adopted for their control? 4

b) The intensity of sound produced by jet engine at take-off is 1 Wm^{-2}. Calculate the intensity level in dB. 3

OR

13. a) Describe with figure, the process of generating ultrasonic waves using piezoelectric crystal. 4

b) A piezoelectric crystal has a density of 3000 kg/m^3, Young's modulus of 60×10^9 N/m^2 and thickness of 0.002 m. Calculate the frequency of the crystal. 3

MODULE V

14. a) How can a diffraction grating be utilized to accurately measure the wavelength of a laser? 4

b) A step-index fiber has a core refractive index of 1.51 and a cladding refractive index of 1.49. If the signal is launched from a medium with a refractive index of 1.37, what is the numerical aperture and acceptance angle? 3

OR

15. a) Illustrate the labeled block diagram of an intensity-modulated fiber optic sensor and detail how the optical fiber responds to force applied to the top block in the sensor arrangement. 4

b) In a laser, light of wavelength 560 nm is emitted when an electron drops from an excited state of energy 9.5 eV to a lower state. What is the energy of the lower state? (Planck's Constant = 6.6×10^{-34} joule second). 3

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