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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 to Electronics and Communication Engineering, Electronics Engineering (VLSI Design and Technology) & Robotics and Automation

(2024 SCHEME)

Course Code : 24BSE1002-B

Course Name : Applied Physics for Engineering

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

PART A

(Answer all questions. Each question carries 3 marks)

1. Define forced oscillations and the concept of resonance.
2. Why do oil films and soap films show different colours in sunlight ?
3. State uncertainty Principle? Write 3 uncertainty relations.
4. List three applications of dielectrics.
5. What is the difference between spontaneous emission and stimulated emission?

PART B

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

MODULE I

6. a) Derive one-dimensional wave equation. Explain the terms of the wave equation $u(x,t) = A \sin(kx-wt)$. 4
   b) Determine the resonance frequency of an LCR circuit consisting of a 90 μH inductor and a 0.001 μF capacitor. Additionally, identify the wavelength where the circuit exhibits maximum response. 3

OR

7. a) What is amplitude resonance. What are the forces acting on a forced harmonic oscillator? What is the equation of Quality factor at resonance. 4
   b) The transverse wave equation of a system is given by $y=6\sin(\pi x-\pi t)$. Compute the wavelength, frequency, and speed of this wave in SI units. 3

MODULE II

8. 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

OR

9. a) For a transmission grating, show that the sine of angle of diffraction is directly proportional to the number of lines per unit length. 4
   b) How many orders will be visible if the wavelength of incident radiation is 6000 Å and the number of lines on the grating is 5500 lines per cm? 3

MODULE III

10. a) Define a wave function. Derive the momentum and Hamiltonian operators. 4
b) Determine whether the wave function ψ = A cos(kx), is an eigen function of the operator $\frac{d}{dx}$, where A and k are constants. 3

OR

11. a) What is quantum confinement? Describe the difference between quantum confinement in zero, one, and two dimensions. 4
b) Consider a particle in a quantum system within the region $0 \leq x \leq 1$, with a normalized wave function $\psi(x) = \sqrt{3}\, ix$. Determine the probability density of the particle. Additionally, calculate the probability of finding the particle in the interval x=0.2 to x=0.8. 3

MODULE IV

12. a) Derive equation of continuity. List any two differences between diamagnetic and ferromagnetic materials. 4
b) A magnetic material exhibits a magnetization of 2500 A/m and a magnetic flux density of 0.001 Wb/m^2. Calculate the magnetizing field strength and the material's relative permeability, given the permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ H/m. 3

OR

13. a) List the four Maxwell's equations. Also, derive the third Maxwell's equation. 4
b) A dielectric material has a permittivity of 4.425×10^{-12} F/m. Given $\varepsilon_o = 8.85 \times 10^{-12}$ F/m, find the electric susceptibility and the dielectric constant of the material. 3

MODULE V

14. (a) Explain the process of measuring the laser wavelength using a diffraction grating. 4
b) A step-index fiber has a core refractive index of 1.54 and a cladding refractive index of 1.52. If the signal is launched from a medium with a refractive index of 1.28, what is the numerical aperture and acceptance angle? 3

OR

15. (a) Describe the optical resonance cavity used in a Ruby laser and its role in the amplification of light. Draw the schematic diagram of a Ruby laser. 4
b) The energy of the ground state is 0.85 eV and the energy of the excited state is 2.50 eV. Calculate the energy difference between the ground state and the excited state in electron volts. Determine the frequency of the photon emitted when the atom make a transition from the excited state to the ground state. (Planck's Constant = 6.6×10^{-34} joule second). 3

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