

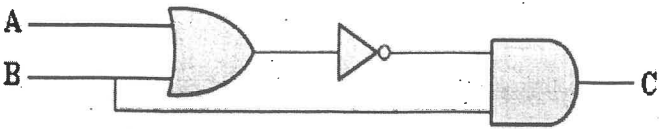
SECOND SEMESTER B.Tech EXAMINATION, MARCH-2024**COMPUTATIONAL PHYSICS****Time: 3 Hours****Maximum Marks: 100****Instructions:**

- I.** Missing data may be suitably assumed.
- II.** Physical constants
- Mass of the electron $m_e = 9.1 \times 10^{-31} \text{ kg}$
 - Charge of the electron $e = 1.602 \times 10^{-19} \text{ C}$
 - Planck's constant $h = 6.626 \times 10^{-34} \text{ Js}$
 - Velocity of light $c = 3 \times 10^8 \text{ m/s}$
 - Boltzmann's constant $k = 1.38 \times 10^{-23} \text{ J/K}$

ANSWER ALL QUESTIONS

		PART-A	5 X 2=10		
1.	a.	Define force constant.	L-1	CO1	02
	b.	Explain the properties of wave function.	L-2	CO2	02
	c.	Illustrate stimulated emission.	L-2	CO3	02
	d.	Explain the construction of optical fibers to satisfy TIR.	L-2	CO4	02
	e.	Outline digital and analog signals.	L-2	CO5	02
		PART-B	6 X 5=30		
2.	a.	Derive differential equation for simple harmonic oscillator.	L-2	CO1	05
		OR			
	b.	A spring undergoes an extension of 5 cm for a load of 50g. Find its frequency of oscillations and time period if it is set for vertical oscillations with a load of 200g attached to its bottom.	L-3	CO1	05
3.	a.	Show that electrons cannot be existed inside the nucleus based on Heisenberg's uncertainty principle.	L-2	CO2	05
		OR			
	b.	The position and momentum of 1 KeV electron are simultaneously determined and if its position is located within 1 Å. What is the percentage of uncertainty in its momentum?	L-3	CO2	05
4.	a.	Explain the requisites satisfied by a laser system with examples.	L-2	CO3	05
		OR			

	b.	Explain the applications of lasers in LIDAR technology.	L-2	CO3	05
5.	a.	Explain the factors contributing to attenuation in an optical fiber.	L-2	CO4	05
		OR			
	b.	Relate the advantages and limitations of optical fiber communication over conventional communication system.	L-2	CO4	05
6.	a.	Interpret exclusive-NOR gates with the help of truth table and gate symbol.	L-3	CO5	05
		OR			
	b.	Describe full adder with figure and truth table.	L-2	CO5	05
7.	a.	Compute the first 2 permitted energy values for an electron in a box of width $2 \times 10^{-10}m$. Write the python code to solve the problem.	L-3	CO6	05
		OR			
	b.	The ratio of population of 2 energy levels is 1.059×10^{-30} . Find the wavelength of light emitted by spontaneous emission at 300K. Write the python code to solve the problem.	L-3	CO6	05
		PART-C	6 X 10=60		
8.	a.	Obtain the differential equation for damped oscillations and solve the equation for the solution for displacement.	L-2	CO1	10
		OR			
	b.	Derive the equations for amplitude and phase of the forced oscillations.	L-2	CO1	10
9.	a.	i. Discuss Eigen values and Eigen functions.	L-2	CO2	06
		ii. Outline the applications of Quantum tunnelling.	L-2	CO2	04
		OR			
	b.	Deduce time-independent Schrodinger's wave equation for a particle in one dimensional potential well of infinite height and discuss the solutions.	L-3	CO2	10

10.	a.	Derive an expression for energy density in terms of Einstein coefficients.	L-2	CO3	10
		OR			
	b.	Describe the construction and working of CO ₂ laser with few applications.	L-2	CO3	10
11.	a.	i. Obtain expression for numerical aperture in terms of refractive indices of core and cladding.	L-2	CO4	07
		ii. An optical fiber has core refractive index 1.5 and refractive index of cladding is 3% less than the core index. Calculate the N.A, angle of acceptance and critical angle between core and cladding.	L-3	CO4	03
		OR			
	b.	Explain the types of optical fibers in terms of refractive index profile and modes of propagation.	L-2	CO4	10
12.	a.	i. Prove De-Morgan's law $A + B = \overline{\overline{A} + \overline{B}}$ with the help of truth table	L-3	CO5	06
		iii. Write the Boolean expression for the logic circuit shown below.	L-3	CO5	04
					
		OR			
	b.	Find the following binary arithmetic.	L-3	CO5	10
		i. 101 + 100			
		ii. 10011 + 1111101			
		iii. 11010 - 01100			
		iv. 1101101 - 0011011			
		v. 1 0 1 1 1 × 1 0 1			
13.	a.	Discuss an experiment to determine the force constant of a given helical spring using simulation.	L-4	CO6	10
		OR			
	b.	Discuss an experiment to determine the refractive index of unknown material medium using simulation.	L-4	CO6	10