U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: II**
Branch: MECHANICAL STREAM **Duration: 3 hrs.**
Course Code: 22PH2BSPME **Max Marks: 100**
Course: Applied Physics For Mechanical Engineering Stream **Date: 30.09.2023**

Instructions: 1. Answer **FIVE** full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Physical constants:

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg
Electronic charge, $e = 1.602 \times 10^{-19}$ C
Boltzmann constant, $k_B = 1.38 \times 10^{-23}$ J/K
Permittivity of free space $= 8.85 \times 10^{-12}$ F/m
Speed of light, $c = 3 \times 10^8$ m/s
Planck constant, $h = 6.626 \times 10^{-34}$ Js
Mass of neutron, $m_n = 1.67 \times 10^{-27}$ kg
Mass of proton, $m_p = 1.67 \times 10^{-27}$ kg

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			MODULE- I	*CO*	*PO*	Marks
1	a)	Describe the construction and working of a semiconductor laser with an energy level diagram.		*CO 1*	*PO 1*	**8**
	b)	Define numerical aperture. Derive an expression for numerical aperture of an optical fiber.		*CO 1*	*PO 1*	**8**
	c)	The average output power of laser source emitting a laser beam of wavelength 6328 Å is 5 mW. Find the number of photons emitted per second by the laser source.		*CO 1*	*PO 2*	**4**
		OR				
2	a)	Define co-efficient of attenuation and give its formula. Discuss the causes of attenuation.		*CO 1*	*PO 1*	**8**
	b)	Derive an expression for energy density of radiation in terms of Einstein's co-efficients under thermal equilibrium.		*CO 1*	*PO 1*	**8**
	c)	Calculate the V-number for a fiber of core diameter 40 μm and with refractive indices of 1.55 and 1.50 respectively for core and cladding when the wavelength of the propagating wave is 1400 nm. Also calculate the number of modes that the fiber can support for propagation. Assume that the fiber is in air.		*CO 1*	*PO 2*	**4**
		MODULE - II				
3	a)	Explain logarithmic decrement, relaxation time and quality factor for a damped oscillator.		*CO 1*	*PO 1*	**8**

		b)	Obtain an expressions for amplitude and phase of a body undergoing forced vibration.	*CO 1*	*PO 1*	**8**
		c)	A damped oscillator of frequency 10 Hz starts with an initial amplitude of 10 cm. After 25 seconds, its amplitude is measured to be 9 cm. Calculate relaxation time and quality factor.	*CO 1*	*PO 2*	**4**
			MODULE - III			
	4	a)	Define Fermi energy and Fermi factor. Discuss the variation of Fermi factor with temperature and energy.	*CO 1*	*PO 1*	**8**
		b)	With a schematic representation describe the Forbe's method of determining the co-efficient of thermal conductivity of a good conductor.	*CO 1*	*PO 1*	**8**
		c)	Calculate the quantity of heat conducted per hour through a concrete ceiling with co-efficient of thermal conductivity of 0.18 W/m-K whose area is 1000 m^2 and thickness 1.5 m, the temperature on either side being 30° C and 60° C.	*CO 1*	*PO 2*	**4**
			OR			
	5	a)	Mention the assumptions of quantum free electron theory and explain any two of its merits.	*CO 1*	*PO 1*	**8**
		b)	State Wiedemann-Franz law. Deduce the classical expression for thermal conductivity of a conductor.	*CO 1*	*PO 1*	**8**
		c)	Find the temperature at which there is 1% probability that a state with an energy 0.5 eV above Fermi energy is occupied.	*CO 1*	*PO 2*	**4**
			MODULE - IV			
	6	a)	State Hooke's law. Explain Young's modulus, bulk modulus and rigidity modulus.	*CO 1*	*PO 1*	**8**
		b)	What is bending moment of a beam? Deduce an expression for bending moment of a beam.	*CO 1*	*PO 1*	**8**
		c)	Calculate the angular twist of a wire of length 0.3 m and radius 0.2 x 10^{-3} m when a torque of 5 x 10^{-4} nm is applied. Rigidity modulus of the material is 8 x 10^{10} N/m^2.	*CO 1*	*PO 2*	**4**
			MODULE - V			
	7	a)	Define packing factor. Calculate the packing factor for BCC and FCC crystals.	*CO 1*	*PO 1*	**8**
		b)	Describe the construction and working of a Bragg's spectrometer and hence explain how it is used for determination of wavelength of X-rays.	*CO 1*	*PO 1*	**8**
		c)	Copper has FCC structure of atomic radius 0.1278 nm. Calculate the interplanar spacing for (3 2 1) plane.	*CO 1*	*PO 2*	**4**

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